POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

More Power for Wartime Loads at Wyandotte

Modernizing Breakers with De-ion Grids

Mechanical Coal Handling Systems

Corrosion in Condenser Piping

Gas Turbines—Part 2

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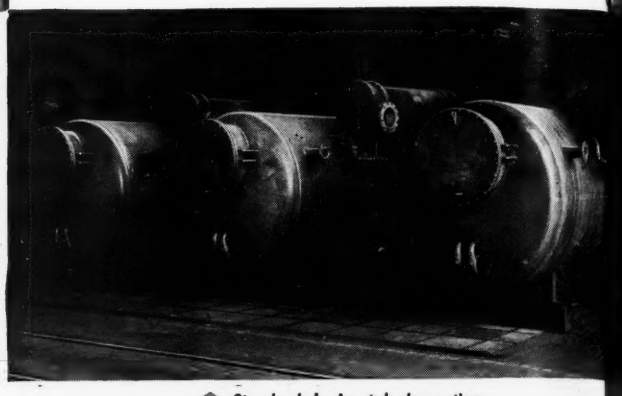
MARCH 1944

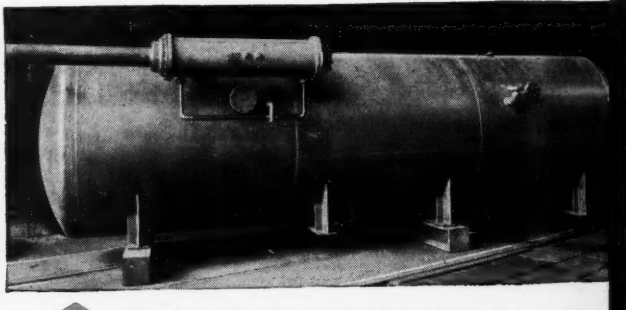
Elliott

This Elliott deaerating heater was built in sections instead of with the shell in one piece so that it would go through the only available opening (a window frame) in the power plant in which it was to be installed.

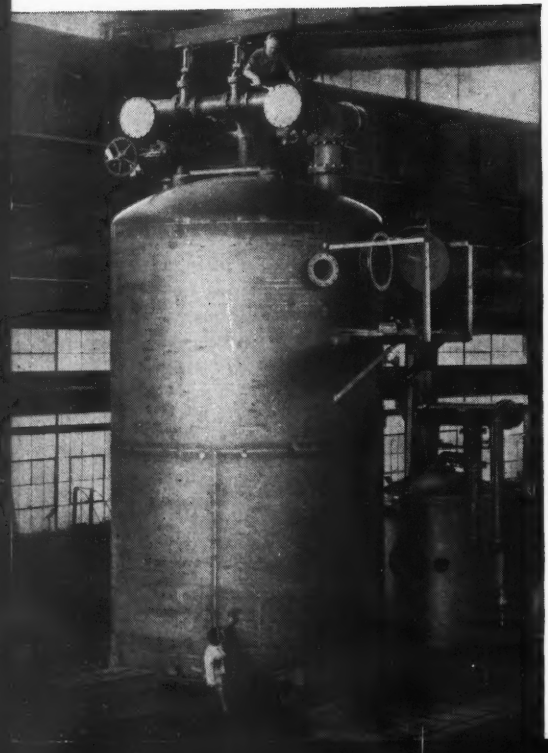
Typical medium-size vertical deaerating heater mounted on a horizontal storage tank. Vent condenser on side to save headroom.



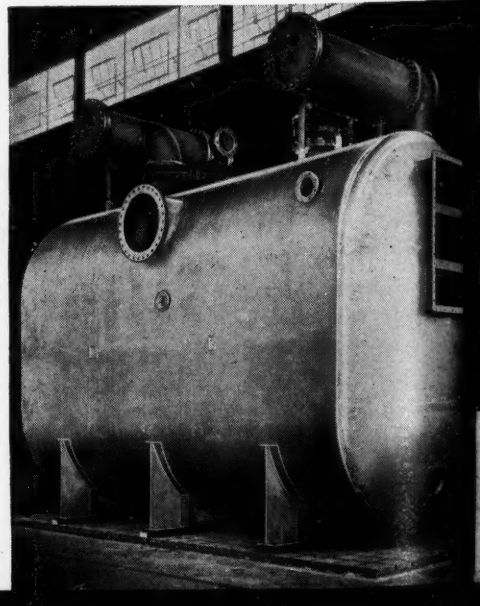
Standard horizontal deaerating heaters with special arrangement of vent condensers to cut down headroom.



A long horizontal unit especially designed to fit into appropriate space aboard a wartime floating power plant.



This 1,500,000-lb.-per-hr. deaerating heater was shaped to fit into limited width in a big utility station.



Two vertical deaerating heaters. Unit at left has twice the capacity of the one on the right, and eight times the storage capacity. It is about as big as can be placed in a railroad car — 12 ft. by 27 ft. high.

TECHNOLOGY DEPT.

engineering gives tailored fit in Deaerating Heaters!

Hardly two deaerating feedwater heater installations are alike in physical characteristics. These units must be fitted to many factors other than the required capacity and operating conditions. The desired amount of storage may mean a large single-shell unit, or a heater with a separate storage tank. Space limitations and available access to buildings must be given first consideration. Railroad clearances limit the size and shape of large units. And with each variation in shape, the critical design areas, volumes, tray and water distribution, piping arrangements, and controls must be proportioned for dependable operation and maximum feedwater heating and deaerating performance.

Obviously you cannot take a standard deaerating heater "off the shelf" and set it to work. It has to be designed, tailored, to fit the conditions. How Elliott engineers fit Elliott deaerating heaters to their jobs is shown in the photos on these pages.

•

If you have a heater problem, particularly one that looks tough, talk it over with these Elliott specialists.

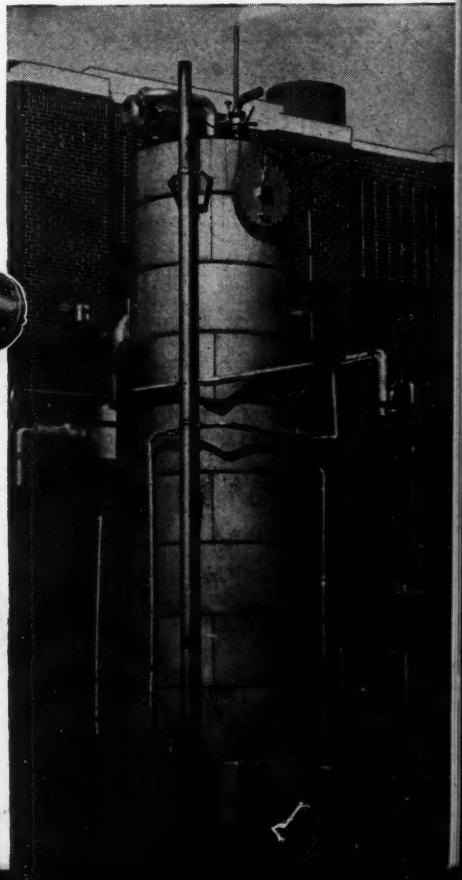
ELLIOTT COMPANY
Deaerator & Heater Division, **JEANNETTE, PA.**
DISTRICT OFFICES IN PRINCIPAL CITIES

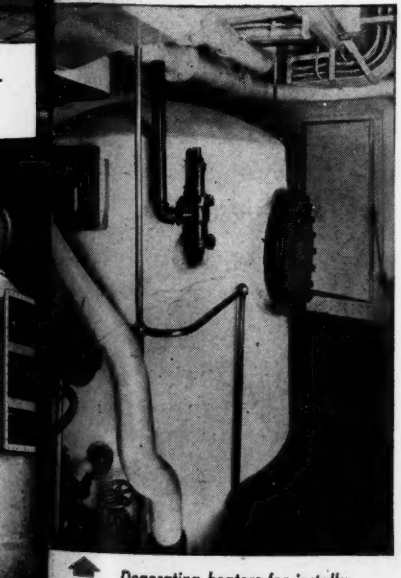
N-975

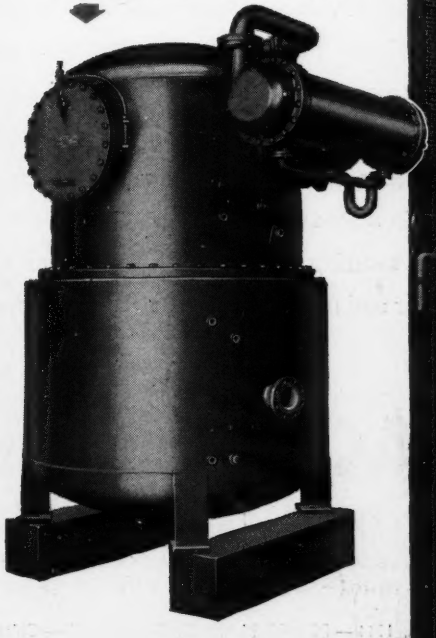
A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

For outdoor installation, this Elliott deaerating heater was made to accommodate large water storage underneath the deaerating heater proper.

Low headroom deaerating heater, for installation in limited space in existing building, constructed so that lower part of unit could be put in place and the upper part slid over it. Vent condenser mounted on side.

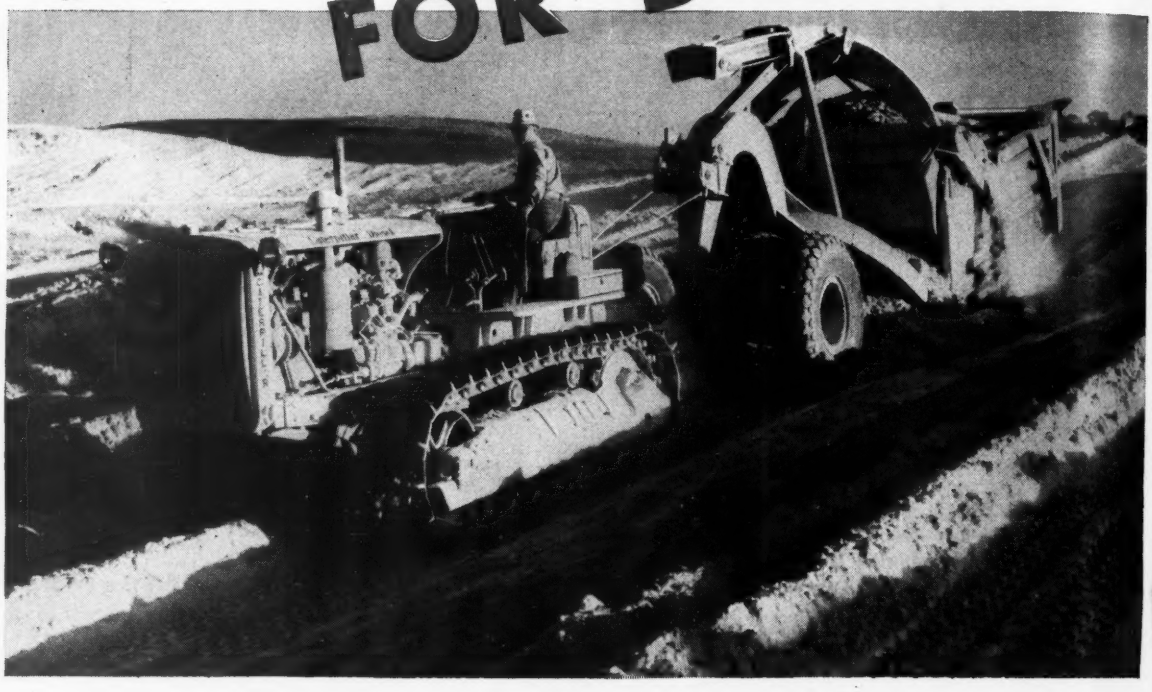






Deaerating heaters for installation on board ship are built with the utmost compactness, usually with internal vent condensers, as illustrated.

BIG SCOOP FOR DIESELS



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VOLUME 48—NUMBER 3

Cover: A view in the boiler room of the Government Synthetic Rubber Plant of the Carbide and Chemicals Corp. at Institute, W. Va. Each of six boilers generates 150,000 lb of steam per hr.
Photo, courtesy Carbide and Carbon Chemicals Corp.

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Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

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Stress of Wartime OVERLOADS *Proves Our Peace-time Claims . .*

When we developed the Hydrojet System of Ash Removal, shortly after the end of World War I, our sole aim was to provide a quick, easy, simple, and clean means of removing refuse from furnaces that were rapidly growing in size and coal burning capacity. "Ton-a-Minute" ash removal with a totally enclosed system changed the wet, dirty ash tunnel into an ash basement, as clean and dry as the turbine room. Ash handling costs were drastically cut and the ash handling crew of several or many men per shift was reduced to the part-time duty of one or two men. . . . The labor and metal shortage brought on by World War II has given the Hydrojet System advantages that we never pointed out to prospective purchasers in peace-time. "Ton-a-Minute" ash removal today means that Hydrojet-equipped plants have no worries about removing ashes, no matter how much coal they burn. Instead of using the system once or twice a day, as in peace-time, they may now use it three or even four times a day. It is so simple to operate, inexperienced help soon catch-on. Maintenance is no problem, for there are no moving parts. Ashes ride on the high pressure water streams in the horizontal sluiceway; they do not roll or scrape along the bottom, thus wear on sluiceway metal liners is small. . . . Plants with Hydrojet Systems have one less thing to worry about these days; those with Hydrovac Systems have two less things to cause them concern.

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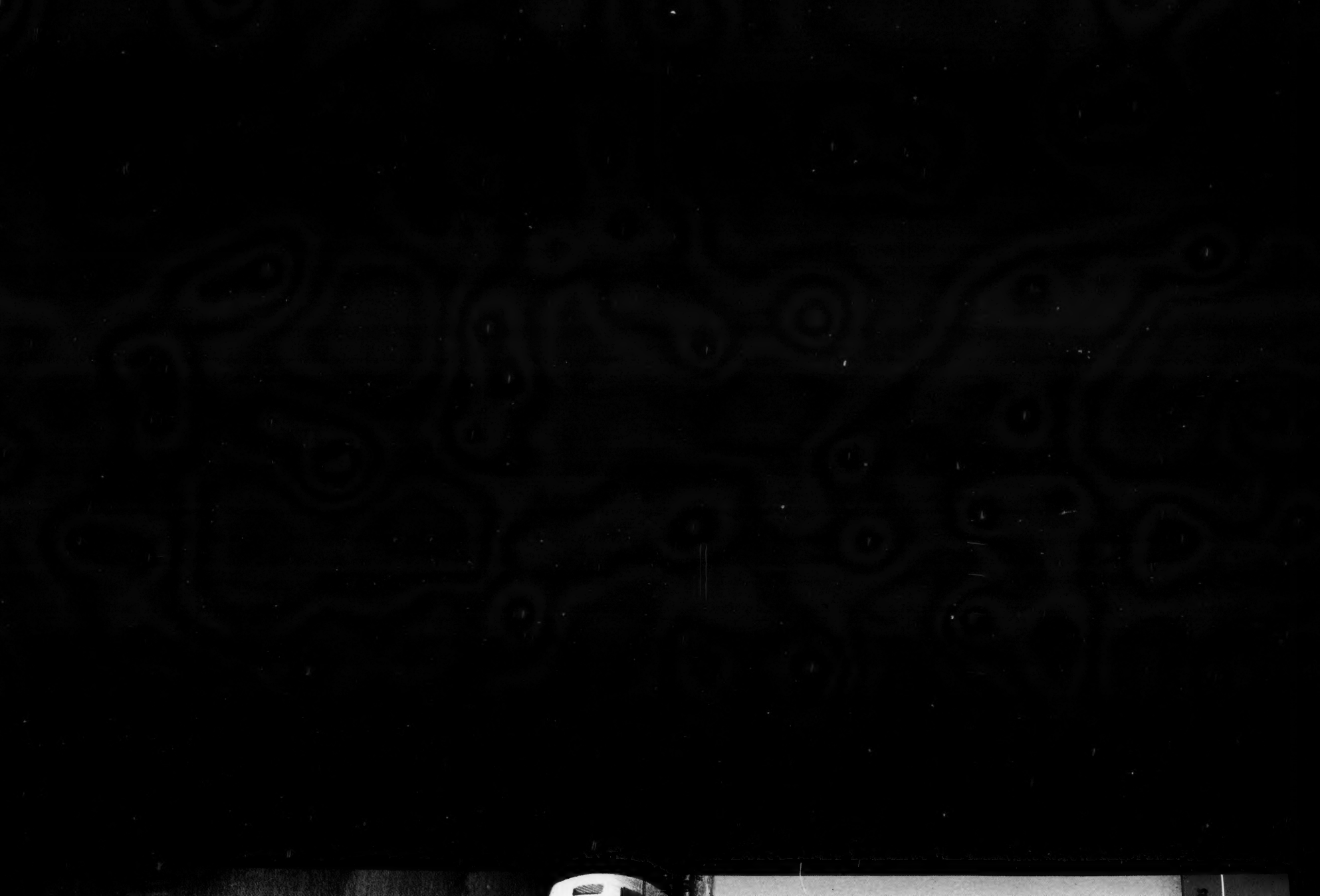

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FRONT LINES

TIP TO POST-WAR planners—if your organization actually has worked out any specific post-war plans, or even if it is merely talking about them and considering all the factors involved, but has not yet reached any definite conclusion, you'll do well to give the employees of your company some information about what you have in mind. It is little wonder, says the C.E.D. News, that many public opinion polls keep indicating that the American people believe the Government must do the planning for the post-war period. People simply do not know that there is a tremendous amount of interest among business men and industrialists in preparing for high levels of employment to build up purchasing power in the post-war period. People prefer some plan, a Government plan, to no plan at all. In one poll, 87.4 per cent of the men employed in one industry said that they would be interested in knowing anything about what industry is planning. Most of them said they supposed industry was making some plans but emphasized the fact that they had been told nothing about them.

DEPARTMENT OF LIBERAL EDUCATION in the House Organs in 15 Min a Day—Stronger Fastenings for Tougher Jobs, a discussion of Monel metal fastenings; also an article on high temperature properties giving tables of properties of Monel, nickel, Iconel and SAE steels, Mechanical Topics, Vol. VII, No. 1, The International Nickel Co., Inc. * * * The Significance of Heatronic Molding, a discussion of the use of electronic heating in molding of plastics; Bakelite Review, January, 1944, Bakelite Corp. * * * How Amsco Conservation Welding Cuts Replacement Costs, showing examples of a number of welding jobs done in reclamation of heavy equipment parts; the Amsco Bulletin, Vol. 15, No. 1, 1944, American Manganese Steel Div. of American Brake Shoe Co. * * * A Just and Durable Peace, a booklet reproducing advertisements and pertinent newspaper comment on this subject; The International Nickel Co. of Canada, Ltd. * * * Chemicals from Salt, a detailed, well-illustrated article about its many uses in industry; also 1000 Feet Per Minute, the first detailed, non-scientific article we have seen about the continuous electrotinning process; this describes the operations at the West Virginia plant of Weirton Steel Co.; The Du Pont Magazine, January-February, 1944; E. I. du Pont de Nemours & Co., Inc. * * * Whither Machine Tools? a look at the future market for them; Central Manufacturing District Magazine; Central Manufacturing District, Chicago. * * * Chemical Products for Post-war Needs, a review of some of the present and future possibilities inherent in our great chemical development; also Dream Houses of Tomorrow, commenting on some of the things we will need for those houses and how they can be produced; Chemical Digest, Vol. 10, No. 1, Spring, 1944; Foster D. Snell, Inc.

FOOTNOTE ON PROGRESS in the power engineering field:—In a regular department of the New York Tribune for January 30, 1944, entitled One Hundred Years Ago in the New York Tribune, appears the following item: "Steam Power to Let—Two large rooms in a substantial warehouse on second and third floor, with steam power equal to eight horses. Apply 247 Water St.—Advt."

INCREASING uses of platinum, palladium and ruthenium in 1943 are reported by Charles Engelhard, President of Baker & Co., Inc. Very little can be said at this time about the specific uses of platinum for they are all involved in the war effort. Palladium has experienced a very active demand during the year, principally for jewelry, dental alloys and electrical contacts. Ruthenium has been used in place of iridium as a hardener of other platinum metals. Knowledge of these metals indicates their greater usefulness in post-war chemical and allied industries for improved processes and new products. For instance, expanded production of fiberglas, rayon and electronics, three modern developments of science, was made possible by platinum.

A FIELD DAY!—that's what it is when a group of engineers gets a chance to design an entire line of equipment right from scratch, using nothing but the latest materials and design ideas, being entirely unhampered by existing construction and able to integrate all services completely and correlate all accumulated experience in design and use of magnet steels, spring materials, new kinds of tools, standardization and unification of parts, frames and sizes and a host of other things. The U. S. Navy called on the electrical industry for the most ambitious instrument design program ever attempted. The Navy felt that it was necessary to retain scale lengths at least as long as in six-inch instruments and at the same time they wanted a space saving design. They requested the industry to return to the long-scale (250-deg) instruments for all fighting ships. According to Westinghouse engineers, a large corps of men worked on this job seven days a week for months and in 16 months the first production units were assembled, a program that would normally require about six years. A-c and d-c ammeters, volt meters, a-c wattmeters, power-factor meters, frequency meters, and synchroscopes were all given the new treatment. The new instruments can be disassembled and repaired easily by regular instrument repairmen with ordinary tools. They had to be extemely rugged to meet the high-shock conditions encountered in naval service. The entire output of these instruments will be required by the Navy for some time but it is expected that the new design will have considerable application on land when available for that purpose.

GEON has been chosen as the name for a group of polyvinyl resins recently developed by B. F. Goodrich Co. for various industrial purposes. Among the principal fields in which they are used are the coating of fabrics, paper, foil and other materials, insulation of wire, manufacture of film for packaging, and the manufacture of extruded and molded products. Purchases of the resins are subject to allocation by WPB although reasonable quantities are available for experimental purposes. They will be supplied either in powdered form, with the compounding done by the purchaser, or in ready-to-use form as granules or sheet. Plastics made of these resins, it is stated, have remarkable combinations of rubber-like properties with nonflammability and resistance to oxidation. Compositions made from others in the series are characterized by resistance to deformation at high temperatures. Because these materials can be varied so widely in useful properties, prospective users should consult the manufacturer.

WILL THE post-war automobile be a tear-drop design, with curved plastic or glass front and top, engine at the rear about the size of a cigar box, burning some incredibly powerful fuel, or perhaps an electrical device picking electricity out of the air, passengers in the car all sitting up in the front, talking back and forth to their homes by means of FM two-way radio and the car protected against collision and accident by Radar? These are the dreams of certain "experts" and "designers" but apparently they do not represent the views of the men who are actually going to have to build the automobiles. For one thing, as we have already pointed out in these columns, the car of the future will not make its appearance for a long time after the end of the war. To maintain full employment and fill the tremendous stored-up demand for automobiles, the automobile industry intends to be in production within six months after the war ends with exactly the same type and model of car that it was producing in 1941. But then what? Can automobile bodies of aluminum, plastic and plywood be built very cheaply by mass production? What about the factors of visibility and eye strain, particularly at night, through one of those beautifully curved plastic or glass fronts in the tear-drop car? How wide would the car have to be to seat three passengers comfortably in the front seat? How would you get in and out of it and where would the doors of the car be located? It is questions like these that have to be answered by the men who are actually going to design and build that dream car of 1954. Well, if you're really interested in knowing what some practical automobile builders think of these things, read the paper on the Practical Postwar Car presented by Edgar C. De Smet, Executive Engineer of Willys-Overland Motors, Inc., before the recent S.A.E. annual meeting at Detroit. Mr. De Smet's conclusion is that it is unfair and unwise to lead the public into believing that the day after Victory Day, or very soon thereafter, they can be assured of entirely new products possessing miraculous features at ridiculously low prices.

SEVERAL hundred of the many more General Electric workers who produced the powerful geared-turbine propulsion sets and a large variety of other operating and ordnance equipment for the U.S.S. Missouri witnessed the launching of the mighty battleship, January 29, via television. All the thrills of the traditional champagne christening and the sight of the enormous 45,000-ton vessel sliding down the ways at the New York Navy Yard were brought to the workers through three television receivers installed in one of the company's tubine shops at Schenectady, 150 miles from the scene of the actual launching. Navy censorship required that a film be made of the launching for the telecast rather than a direct pickup from the New York Navy Yard. The telecast was on the air six hours after the launching.

THAT CONTINUOUS SOUNDER-OFFER, Ambitious Al, sounds off again, this time about natural circulation versus forced circulation boilers. "I was much interested in Mr. Karassik's article on the Stabilized Circulating Cycle in the January issue," he writes, "also in the details of the 2500-psi Twin Branch boiler. I understand that after the various changes were completed in this unit, the natural circulation problem has ceased to exist. I do think, however, just as soon as equipment can be released so that new boilers can be installed in certain plants where they are urgently needed, there will be a great deal of discussion about the merits of natural versus forced circulation for boilers. This discussion will come up, because, as Mr. Karassik points out in his article, a great many engineers feel that there are possibilities of increasing capacities of existing boilers by changing them to forced circulation, or making new boilers more compact. But another aspect of forced circulation was mentioned to me not long ago by a leading utility power engineer. He believes that the principal value of forced circulation is not so much in increasing capacity as in permitting boiler designers to redistribute the various heating surfaces of the boiler to meet the heat transfer requirements more effectively without having to worry about circulation. This, he thinks, may bring about important modifications in boiler design."

THE AMERICAN PEOPLE are only beginning to realize that something has been going on in Europe during the past 25 years that was entirely different from what they supposed was going on. For example, it now begins to appear that Russia has developed a much-modified socialist set-up. This is not news to a great many engineers who have done engineering work for the Russians. Furthermore, a great deal of the information about what was happening has been published in articles and books. This published material, however, has apparently been read by only a handful of our population. In a similar way, the full story of what has been going on in France for 25 years is available in articles, in books, and in a great many reports from newspaper correspondents. It is only now becoming clear that the forces leading to the present predicament of France have been operating for a long time. The same thing is true of Italy, Germany, Japan, and many other countries. The information was there all the time, if we had been willing to pay attention to it. But as usual, the American people will be amazed when the true story of what actually happened is brought out after this war, just as it was after the first world war.

DEVELOPMENT of multipore, a filter material containing as many as 6400 perforations to the square inch, is now being used by chemical plants, food factories, medical manufacturers, coal and iron mines, steel mills, liquor distillers, and many other types of industry. These filter screens, developed by U. S. Rubber Co., are made of either hard or soft rubber, and may be compounded to resist abrasion, high temperatures, alkaline and acid solutions, as well as certain oils and greases. Since they are made only from natural rubber latex of the Hevea tree, now one of the most critical of all materials, the filter can be applied only to the most important products. In soft coal mines, coal dust which formerly was lost, is now recovered from processing water by these rubber filters. This saving increases production from 200 to 300 tons per day at individual mines.

IN VIEW of the current interest in the jet propulsion airplane referred to here, also in the rocket guns and rocket planes used in this war, it may be expected that a number of ideas for applying their principles to post-war purposes will be developed. One of these was referred to by Drew Pearson in his broadcast of Sunday, January 9. He stated that a proposal has been made for the transmission of mail in projectiles powered by rockets which would travel in tubes or pipes laid along the rights of way of our present railroads. In view of the widespread use of pneumatic tubes for mail transportation in some of our larger cities, this idea is not too fantastic. Just how it would compete with the activities of the railroads and the airplane in carrying first class mail is not clear.

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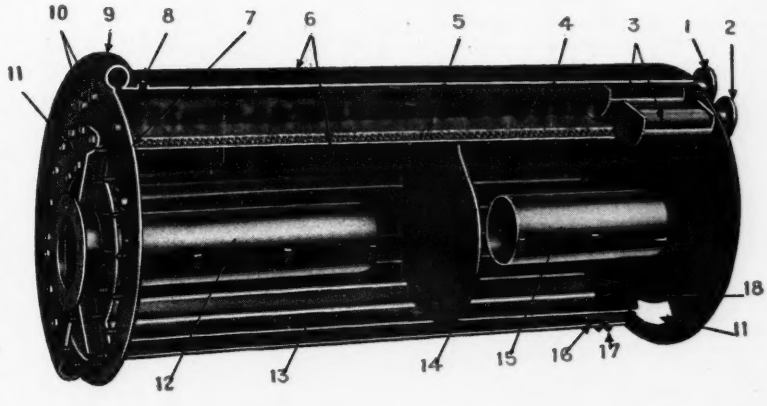
Maxim Heat Recovery Silencers convert waste exhaust heat into steam or hot water for industrial processing operations or for heating.

These Heat Recovery Silencers provide effective silencing of exhaust noise and are available with or without the spark arrestor feature.

A highly efficient heat transfer is achieved through high mass gas velocities and the use of extended heating surfaces. Because of this type of construction (no tubes) it is possible to run dry without damage to the unit. Automatic control of water level through steam pressure regulated valves controls steaming rate, and because the unit can be run with or without water, complete automatic control of output is possible.

Maxim engineers will be glad to work with you to determine the most efficient set-up for your particular case. Maxim Bulletins WH-100, WH-102 and WH-103, describing these Heat Recovery Silencers, will be sent to you on request.

For silencing, without the heat recovery feature, investigate the broad range of usefulness covered by Maxim Silencers . . . for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



1—Steam Outlet
2—Safety Valve Connection
3—Dry Pipes
4—Steam Space
5—Water Line
6—Shells—Cylindrical to withstand steam pressure and pulsating gas flow
7—Inlet Head
8—Pressure Gauge Connection
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10—Water Gauge Connections
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15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

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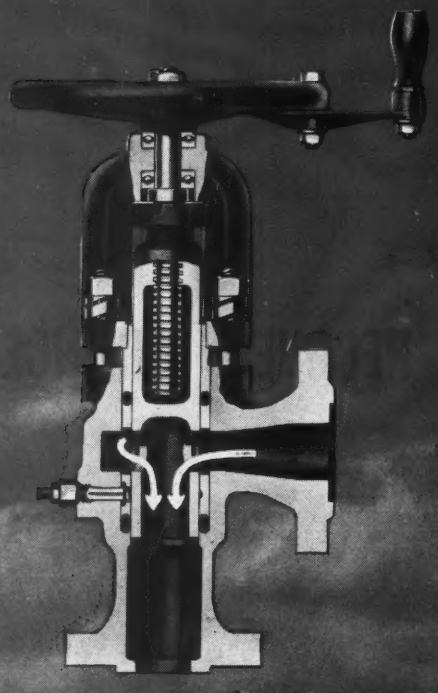


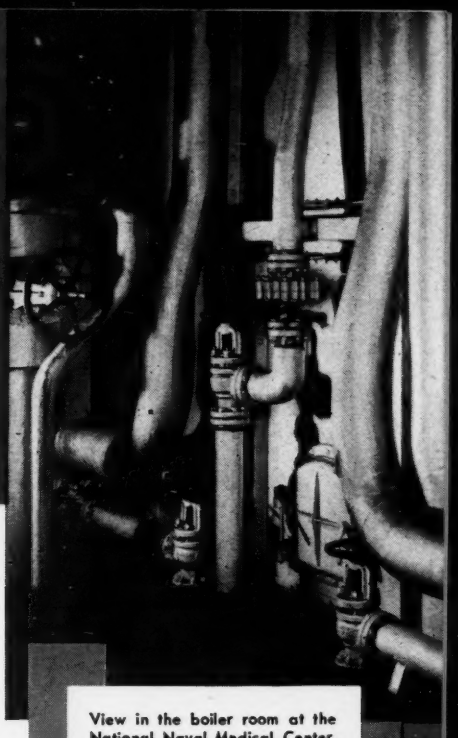
The Yarway Seatless Blow-Off Valve with no seat to score, wear and clog.

The recently completed National Naval Medical Center at Bethesda, Maryland, equipped with sixteen sets of Yarway Tandem Blow-Off Valves. Paul P. Cret, Consulting Architect.

YARWAY

Yarways

FOR TROUBLE-FREE BLOW-DOWN SERVICE



Where 100% dependability is paramount, as in hospital service, Yarway Blow-Off Valves are generally the choice.

At the 1,000-bed National Naval Medical Center, Bethesda, Maryland, sixteen sets of Yarway Tandem Blow-Off Valves are in use on the four boilers which heat this showplace of modern efficiency and architectural beauty.

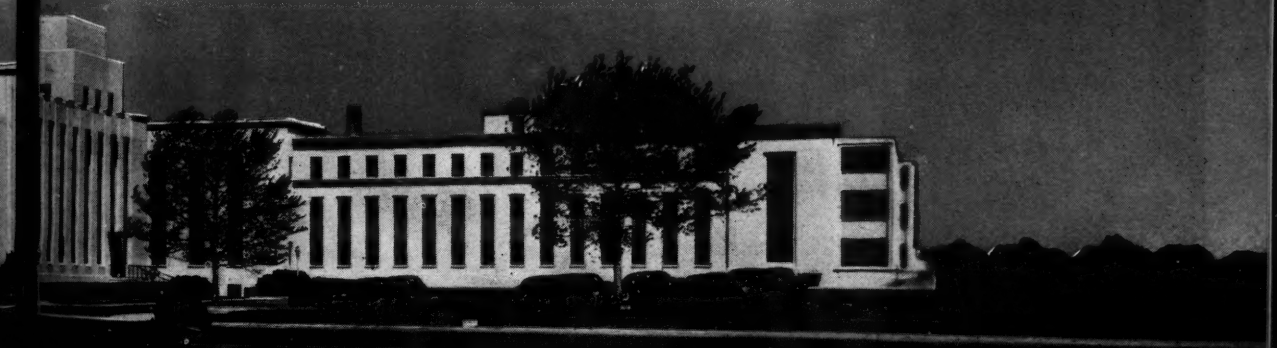
The valve arrangement used is the popular favorite with many thousands of heating plants—the quick-opening, straight-through-flow Yarway Double-Tightening Valve in tandem with the positive-sealing, Yarway Seatless Valve, with no seat to score, wear and clog with mud, scale and dirt.

Whatever your blowing or draining and sealing requirements, there is a Yarway Valve combination designed expressly for that service. Write for Catalog; section B-422 for pressures up to 400 lb, section B-431 for pressures up to 2500 lb.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

View in the boiler room at the National Naval Medical Center, Bethesda, Md., showing a few of the 32 Yarway Blow-Off Valves installed in this hospital.

Eighty Yarway Cylinder-Guided Expansion Joints also are in service on steam lines throughout this building.



BLOW-OFF VALVES

STEAM FOR INDUSTRY'S WAR JOB

Freedom as we have always known it is worth any effort needed to preserve it, and, for that reason, America is today defending with the combined resources of the nation our right to continue living in our established pattern. Industry's part of the war job is its vast production of ships, tanks, guns, and other kinds of fighting machines and materials.

And in the background of this visible and more dramatic production operate the public utilities, supplying unrationed power for both war and civilian needs at a rate never before attained.

Since B&W Boilers are supplying the steam in a large proportion of these pub-

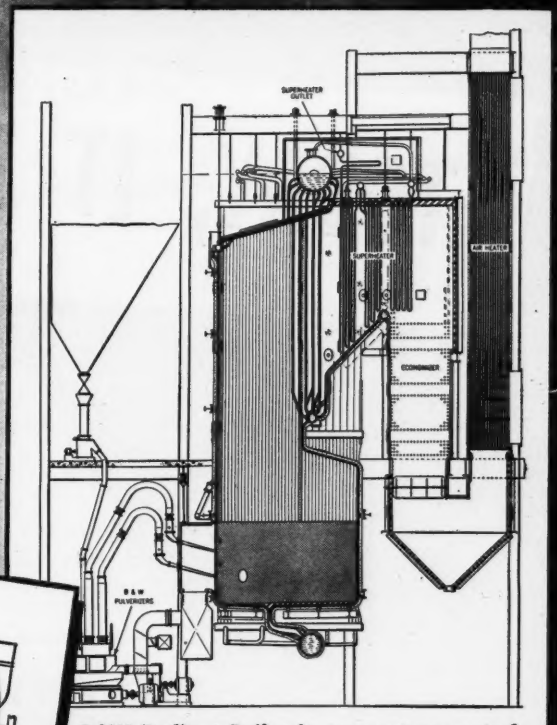
The Army-Navy "E" with two stars and Maritime Commission Award flags are floated proudly at the Barberton Works.

BABCOCK & WILCOX

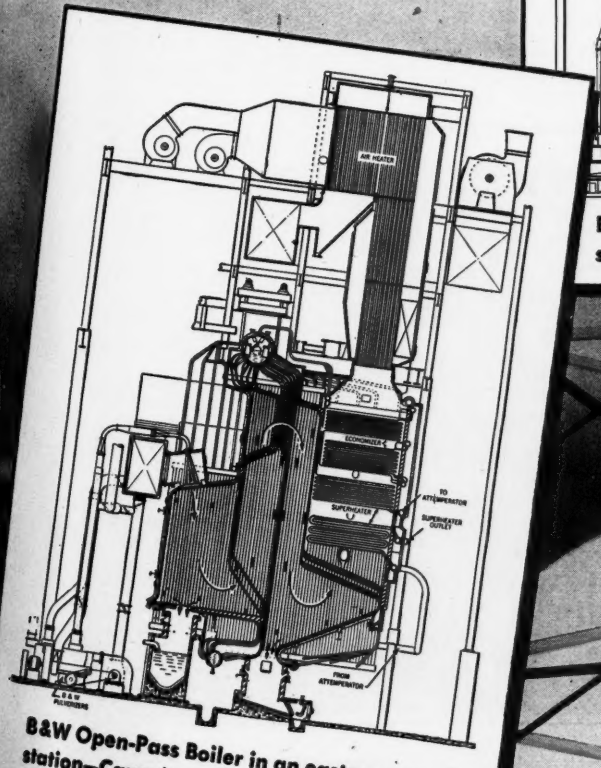
B&W

lic utility and industrial power plants, and for propelling naval and cargo ships, B&W is playing a substantial part in this great war effort. B&W engineering and production skill have built into its boilers the stamina to endure today's gruelling drive.

With today's accelerated experience yielding more complete answers to such problems as behavior of metals at high temperatures, action of fuels in slag-tap and dry-ash furnaces, circulation in high-capacity high-pressure boilers, separation of steam from water in boiler steam drums, and other related problems, the boilers of tomorrow should be even better able to serve industry.



B&W Radiant Boiler in an eastern central station—Capacity 400,000 lb. steam per hr.

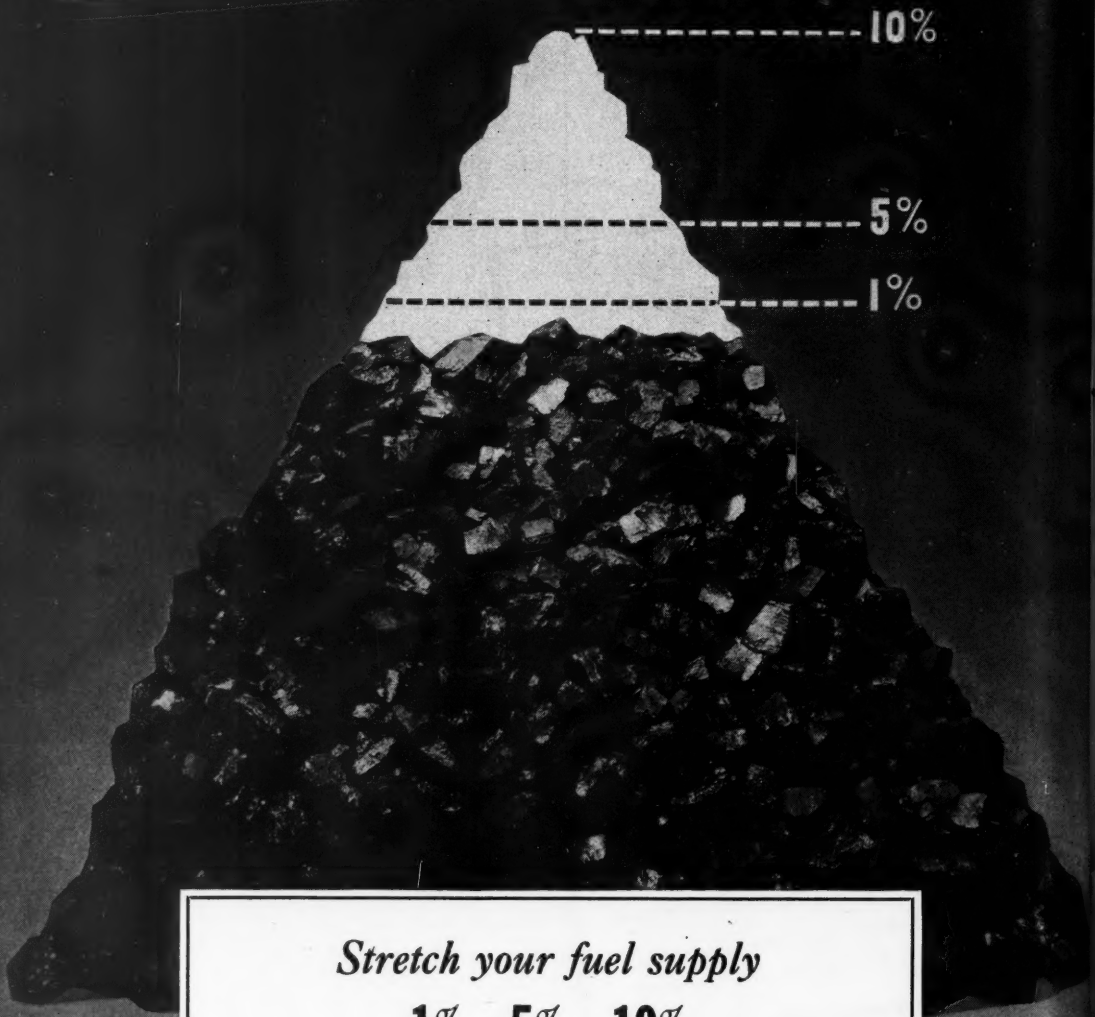


B&W Open-Pass Boiler in an eastern central station—Capacity 350,000 lb. steam per hr.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET NEW YORK 6, N. Y.

G-254

TODAY, IT IS SMART TO B



Stretch your fuel supply

1% 5% 10%

Automatic Combustion **Control has probably done more to conserve the nation's fuel supply than any other single thing. If your plant has an old inefficient system or none at all, get in touch immediately with a *control* manufacturer.**

BE A "COAL-MISER"

— especially when you can improve overall operating efficiency at the same time!

ENGINEERS in hundreds of America's leading power plants are thankful that they had the foresight to equip their boilers with Hagan Automatic Combustion Control.

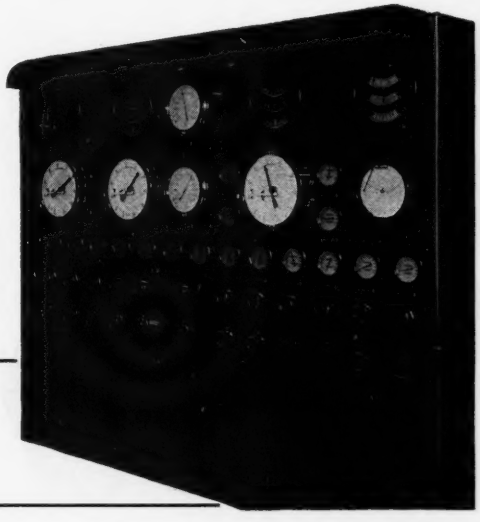
Today, coal has suddenly become a scarce commodity. Stretching what you have from 1 to 10 per cent through better combustion efficiency takes on special importance.

You *can* get such results, even though your firing equipment is *good*. Under less favorable conditions, a greater saving is not uncommon.

Reduced fuel consumption is just *one* of the many advantages offered by Hagan Control. Sound engineering and rugged construction make Hagan Control fast, accurate and dependable. How dependable is strikingly illustrated in a story just released by the War Shipping Administration.

An Africa-bound freighter had a 20 by 30-foot hole torn in her side by a torpedo. She was making tons of water, heeling over and settling down 12 feet by the head when the captain gave the "abandon ship" order . . . but that ship didn't sink! When engine department volunteers returned aboard they found that the plant was still seaworthy. The Hagan Automatic Combustion Control was still on and maintaining steam at the same pressure as before the "abandon ship" order was given. The freighter zigzagged to safety and continued on to port, 850 miles away!

Just those two factors — reduced fuel consumption—absolute dependability—are in themselves enough to warrant full inquiry. Shall we give you further information?



HAGAN
HALL
BUROMIN
CALGON

6.7% Coal Reduction per K.w.h. by this installation of Hagan Automatic Combustion Control in a medium-sized power plant.

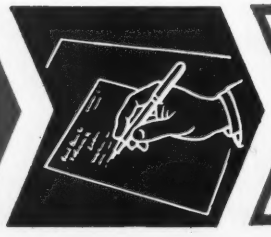
HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

You Save[1] and Save[2] and Save[3] an

1 SAVE ORDERING TIME



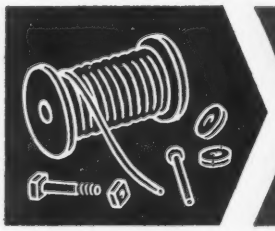
Instead of buying two separately mounted devices—a motor-circuit switch and a magnetic starter—you buy one factory-co-ordinated unit that controls and protects your motor. Simply specify the motor rating and indicate the type of motor-circuit switch you want—and we'll send you the control you need.

2 SAVE INSTALLATION TIME

Users report a 50 per-cent reduction in mounting time, 40 per-cent reduction in wiring time, as compared with the installation of two separate devices. You mount one device—not two. You connect only nine terminals—not fifteen. You get your motors into operation quicker.

3 SAVE MAN POWER

By eliminating one complete mounting job on every installation, you save valuable man power. And because the cover cannot be opened while there is power on the starter, your men have more protection against accidental injury.

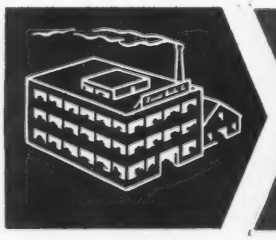


4 SAVE CRITICAL MATERIALS

By buying both the motor-circuit switch and the magnetic starter as one compact unit, you save copper wire, steel conduit, and fittings that are necessary for installing two separately mounted devices—plus the saving gained by using only one steel enclosure instead of two.

5 SAVE MONEY

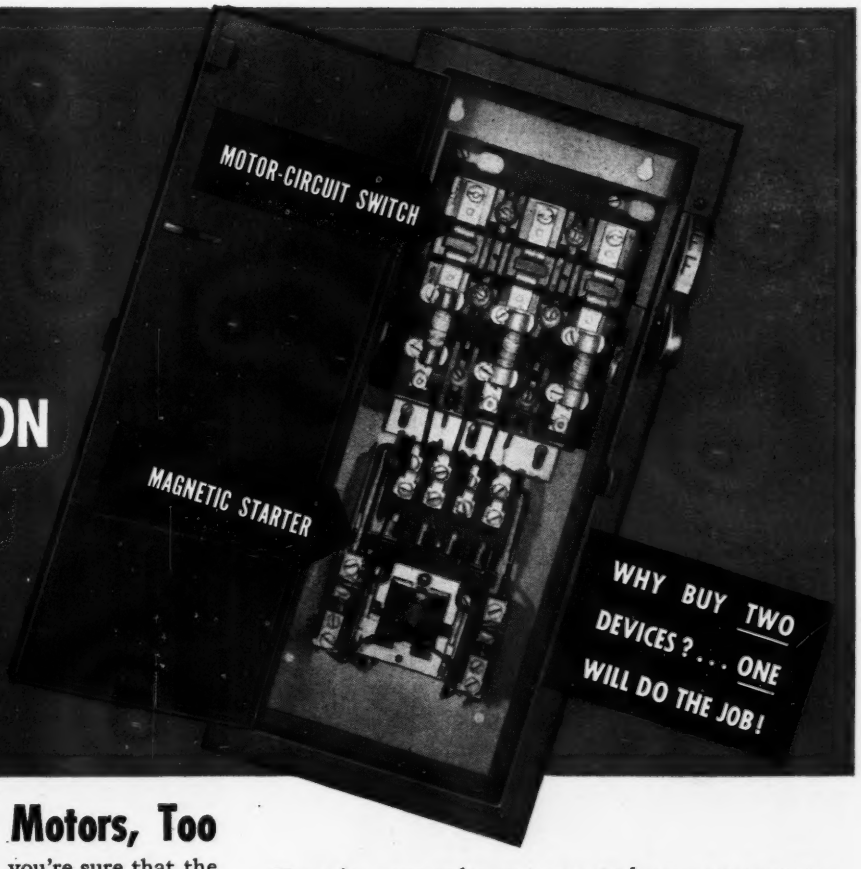
Combination starters cost slightly more than two separately mounted devices, but this difference is more than made up by the savings in wire, conduit, fittings, and installation-labor costs. This statement is based on the actual experience of users.



6 SAVE PLANT SPACE

Combination starters take up less mounting space than separately mounted safety switches and starters. Because of this you can mount them in small, unused places near the operators.

and Save[4] and Save[5] and Save[6]...



COMBINATION STARTERS

---and Save Your Motors, Too

With G-E combination starters, you're sure that the motor-circuit switch or breaker has the proper rating and interrupting capacity for the magnetic starter with which it is used. The fuses or breaker are coordinated with the thermal overload relays to give complete motor protection under short-circuit or overload conditions.

It's the simple, logical way to get control and protection for your motors—in one compact, easy-to-install unit. Why buy two devices, when this one will do the job?

NAME YOUR HAZARD

G-E combinations come in enclosures to meet any operating condition: dust-tight, watertight, oil-immersed, general-purpose, or for hazardous locations. Available for motors from 1 to 1000 horsepower.

GENERAL ELECTRIC

Next time you order motor control, save seven ways by specifying General Electric combination starters.
General Electric Company, Schenectady, N. Y.

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

General Electric Company, Section F676-129
Schenectady, N. Y.

Please send me the bulletins checked below:

- GEA-3715—Combination starters: general-purpose, watertight, and dust-tight
- GEA-3660-2300-volt combination starters
- GEA-3804—Combination starters for hazardous locations
- GEA-3541—Oil-immersed starters

Name.....

Company.....

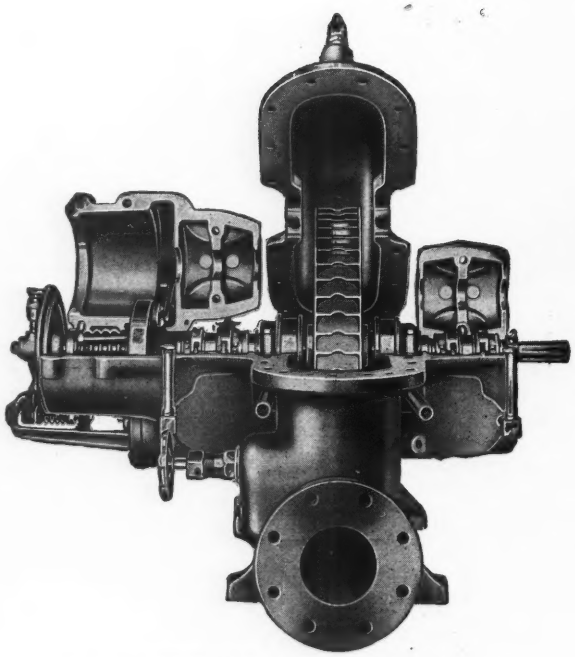
Address.....

City.....State.....

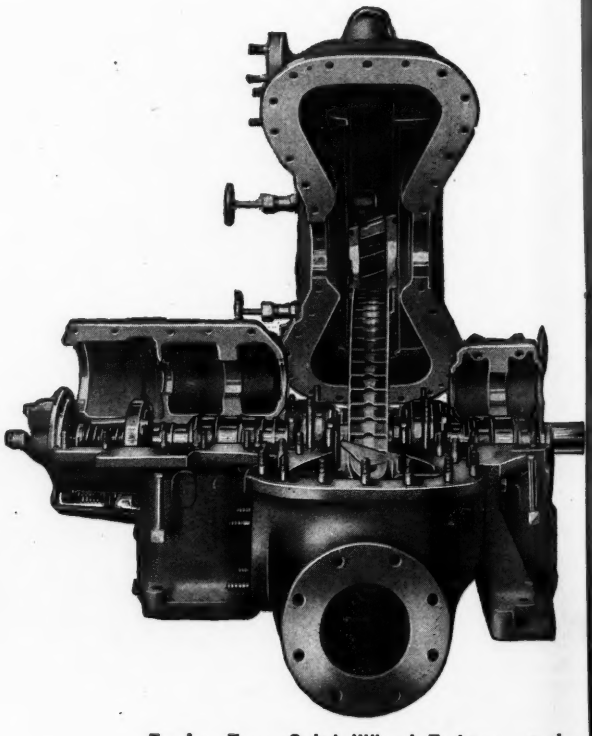
8920

The TERRY

OFFERS COMPLETE COVERAGE OF MECHANICAL DRIVE TURBINES



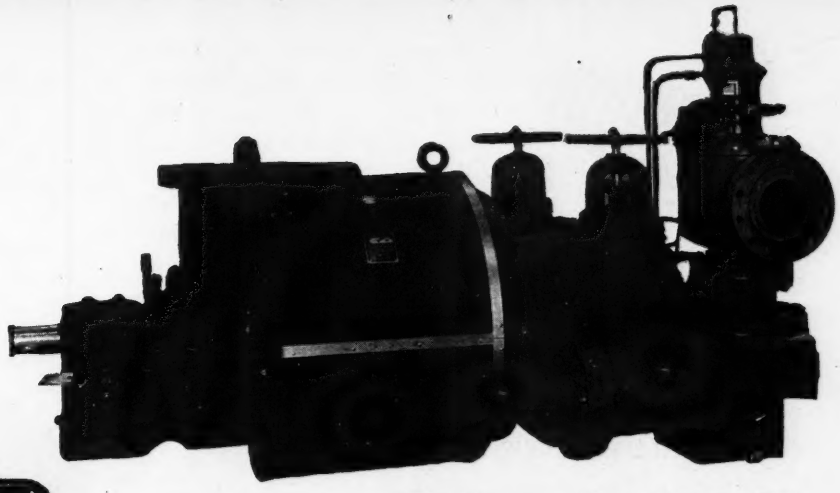
Terry Solid Wheel Turbine with Top of Casing Raised. Note the ruggedness and the ease with which the interior parts can be inspected — one of the country's leading oil companies employs 308 of these units for driving various types of refinery pumps. Full details are available in Bulletin S-116.



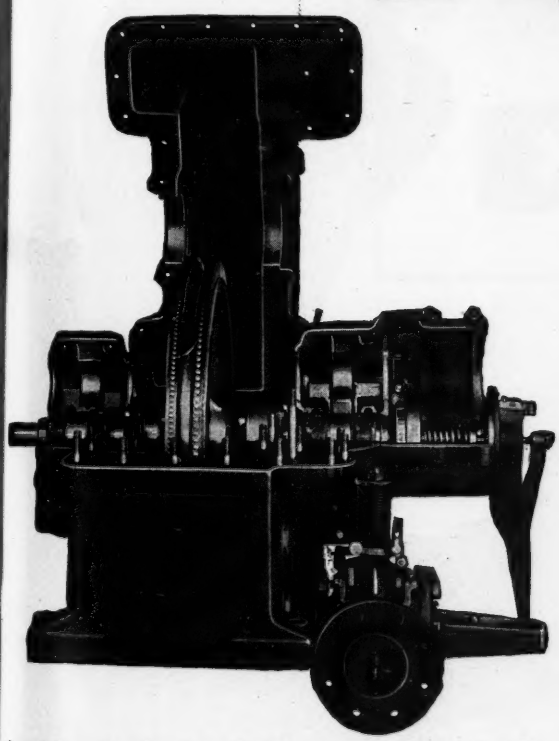
Twelve Terry Solid Wheel Turbines, similar to the above unit, drive auxiliaries in the power house of an east coast refiner. They operate with steam at 625 lbs. pressure — 700° Total Temperature. Eight of the machines exhaust against 125 lb. back pressure. The first of these units was purchased in 1931. It proved entirely satisfactory so that as the plant was enlarged, duplicate Terry's were added. Bulletin S-99.

THE TERRY STEAM TURBINE CO.

TURBINE



1200 Horsepower Terry Multi-stage Turbine. Units of this type are employed extensively for driving large refinery pumps. The units may be designed for non-condensing, condensing, mixed pressure, or bleeder operation. They may be equipped with constant speed or variable speed governors, remote speed controls or with special governors to meet unusual requirements. Ask for Bulletin SR-114.

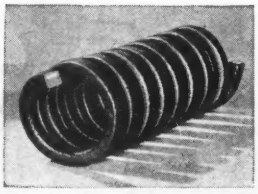


Axial Flow Impulse Terry Turbine — one of a complete line — built with either two or three rows of blading. These units, like all Terry turbines, are the result of over 45 years of successful experience in the manufacture of turbine drives exclusively. Completely described in Bulletin S-107.

T-1151

TERRY SQUARE - HARTFORD, CONN.

Win the War in Forty-Four!



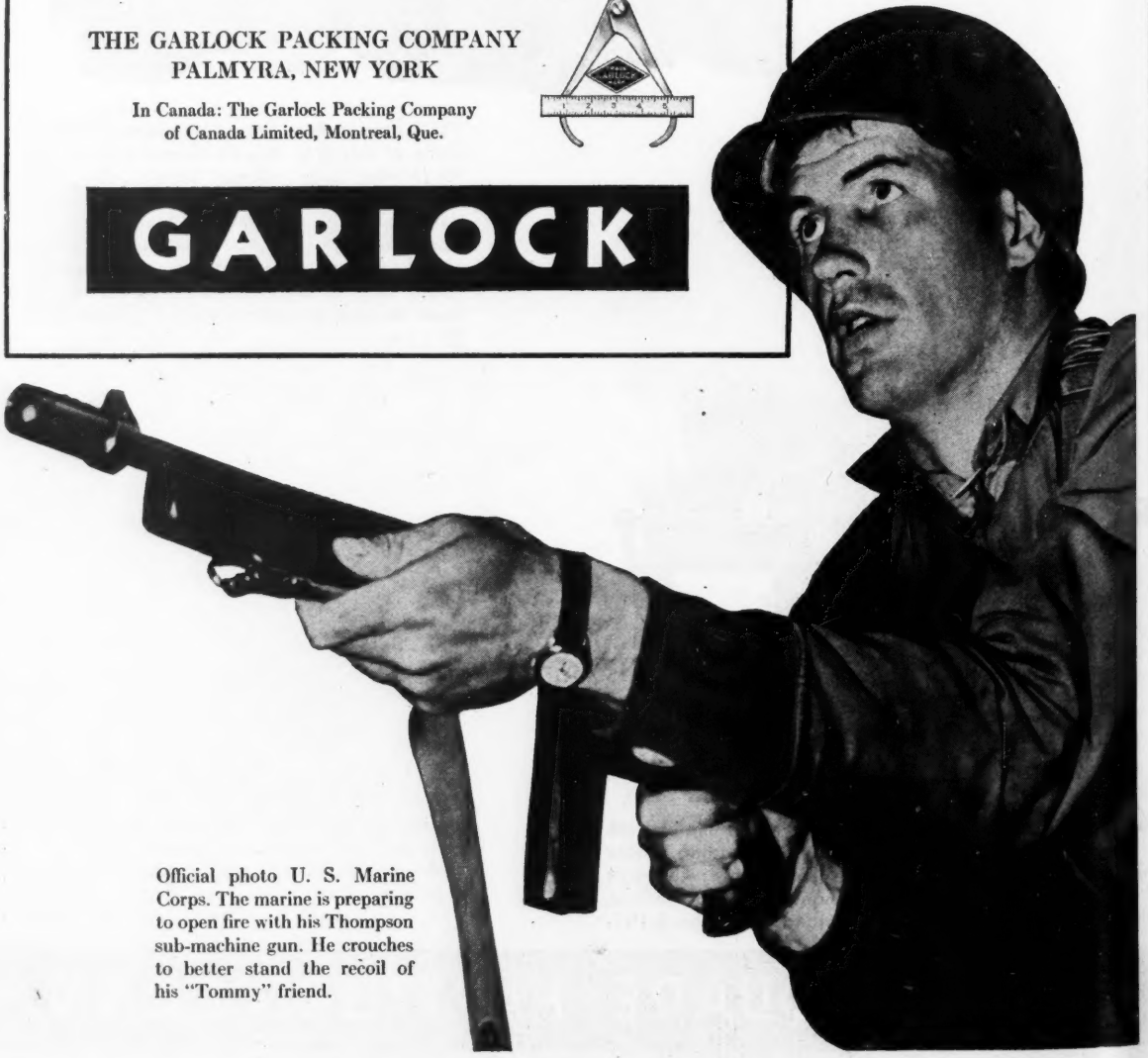
GARLOCK 150 Rod Packing for High Pressure Steam (Spiral form). Coil form—GARLOCK 125. Ring form—GARLOCK 200.

Every day we are producing tons of GARLOCK Packings, Gaskets and KLOZURE Oil Seals for the U.S. Armed Forces and War Industries. Their dependable performance will help the effort of the United Nations to *win the war in '44*. Essential civilian industries are also being supplied with GARLOCK products to the limit of our capacity.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

GARLOCK

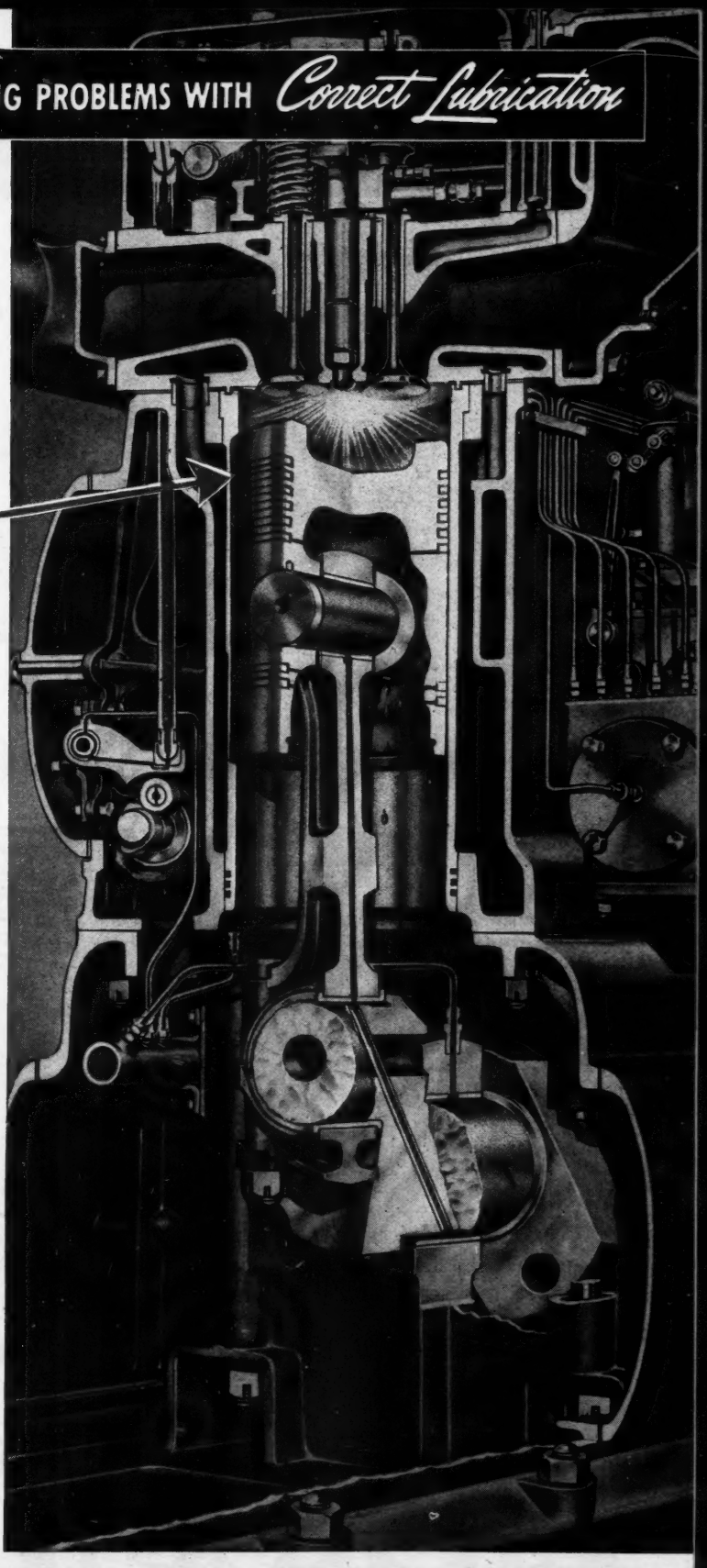


Official photo U. S. Marine Corps. The marine is preparing to open fire with his Thompson sub-machine gun. He crouches to better stand the recoil of his "Tommy" friend.

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE OPERATING PROBLEMS WITH *Correct Lubrication*

GET *Full Power* WITH *Free Rings!*



IN DIESEL ENGINES like this, a vital lubrication problem is to keep rings, pistons, and valves free from hard carbon deposits.

This calls for special oils that will not only resist the formation of deposits but will make certain that any deposits which do form are soft and fluffy. These oils also must provide strong films (even when squeezed to microscopic thinness) to protect against wear.

Gargoyle D. T. E. Oils are specifically designed to meet these exacting requirements. They're made from specially selected crudes, and refined to stand up under the highest temperatures and pressures of Diesel operation.

•

Socony-Vacuum Oil Co., Inc.

Standard Oil of N. Y. Div., White Star Div., Lubrite Div., Chicago Div., White Eagle Div., Wadhams Div., Magnolia Petroleum Co., General Petroleum Corporation of California.

GARGOYLE

Lubricants

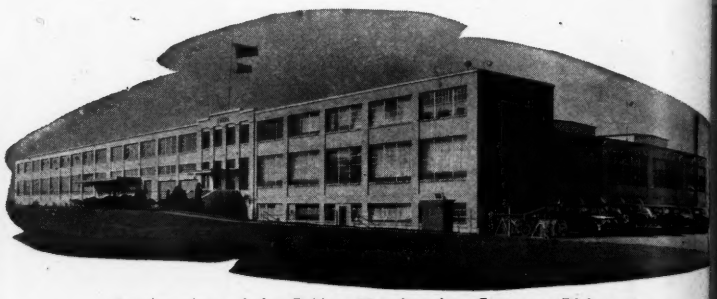
ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

CALL IN SOCONY-VACUUM

Boiler Capacity Up...

Fuel Cost Down

WHIPPLE JACOBS, *President*
Belden Manufacturing Company



Exterior view of the Belden Manufacturing Company, Richmond, Indiana, well known makers of insulated copper wire, cable and cordage.

IRON FIREMAN STOKER Saves Over $3000 a Year at Belden Manufacturing Co.

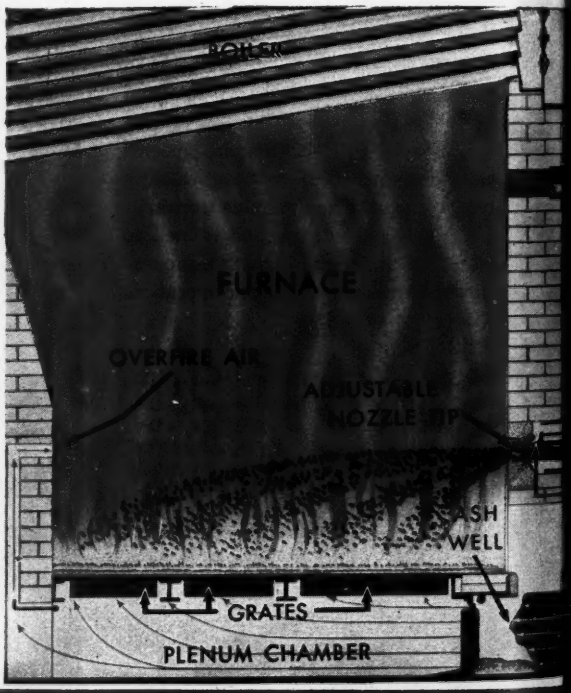
★ "In addition to providing a required increase in the capacity of our old boilers, we have reduced operating costs by $3,293 annually," reports D. D. McQuiston of the Engineering Department of Belden Manufacturing Company.

The Iron Fireman Pneumatic Spreader stoker model as used by Belden permits the use of local and lower cost coal, a vital advantage now when the transportation bottleneck presents serious difficulties. This greater efficiency and lower fuel costs are typical of thousands of war production plants that have changed to automatic coal firing.

Convert to Automatic Coal Firing Now

If your power or heating plant is now oil-fired, or if you operate an essential business or industry, you are eligible to apply for an Iron Fireman stoker under WPB regulations.

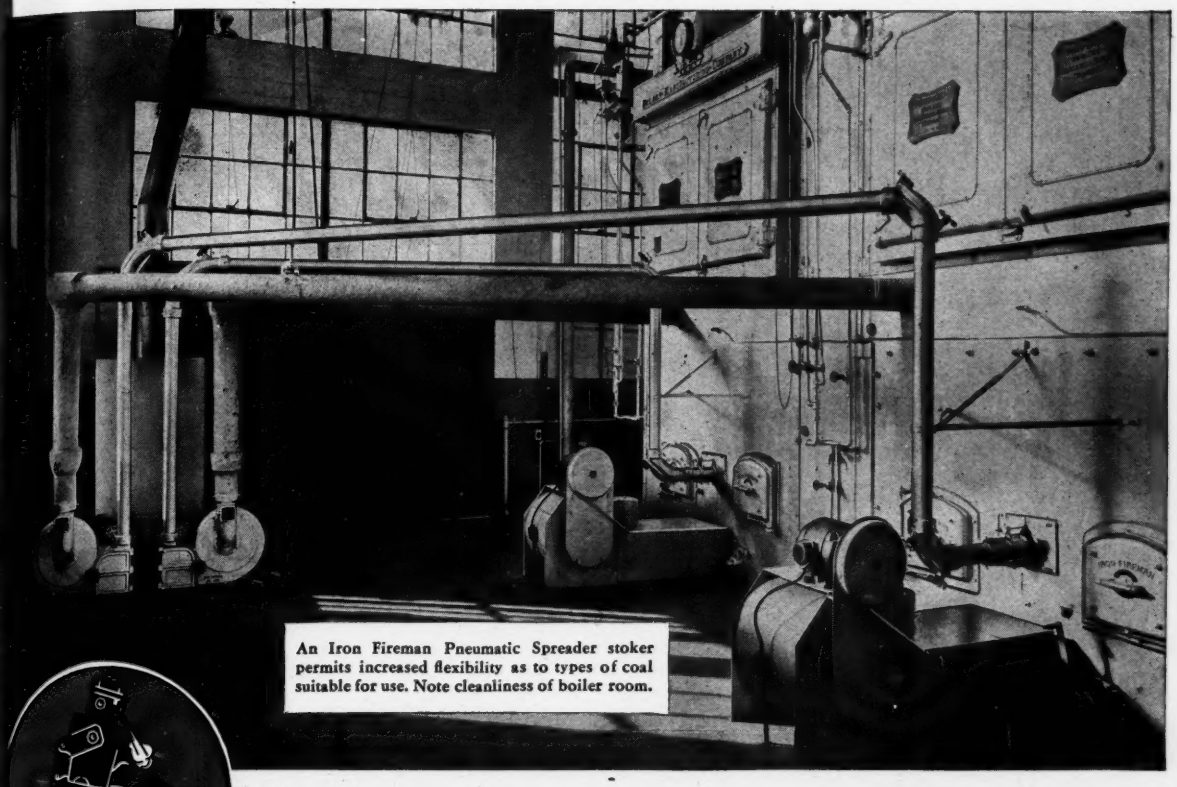
Phone, wire or write Iron Fireman Manufacturing Company, 3290 West 106th Street, Cleveland, Ohio.



IRON FIREMAN

THE IRON FIREMAN

Automatic Coal Stokers



An Iron Fireman Pneumatic Spreader stoker permits increased flexibility as to types of coal suitable for use. Note cleanliness of boiler room.

THE IRON FIREMAN

PREHEATED AIR PIPE

Coal Conveying Pipe

Nozzle Adjustor

Coal Nozzle

Forced Draft Fan Motor

Transfer Housing and Conveyor Fan Housing

Connection for Combustion Control

Conveyor Fan Motor

FORCED DRAFT FAN

COAL HOPPER

BUNKER-FEED MODELS

Coal is conveyed automatically from the bunker to the boiler

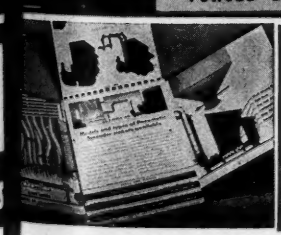
Coal Conveyor Pipe

Worm Housing Cleanout

Feed Worm

Coal Feed Motor

Transmission



FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3290 W. 106th Street, Cleveland, Ohio.

Engineering

A TURBINE TO UTILIZE A MILLION POUNDS OF STEAM PER HOUR

It takes a lot of steam to make a pound of synthetic rubber—approximately 40 pounds. In a 100,000 ton-per-year Buna S plant, for example, a million pounds of steam per hour can be harnessed. And recently, Westinghouse engineered such a job.

Westinghouse steam engineers designed a 35,000 kw noncondensing turbine generator—with immense twin throttle valves.

Steam was supplied at 700 pounds, 750°—exhausted at 165 pounds. The entire unit, huge because of unusually low steam pressure, was enclosed in an attractive, streamlined housing.

This turbine application, involving many special requirements, was designed quickly and efficiently by Westinghouse. Similarly, your steam problems, now or postwar, can be solved by Westinghouse engineering. Call Westinghouse for details.

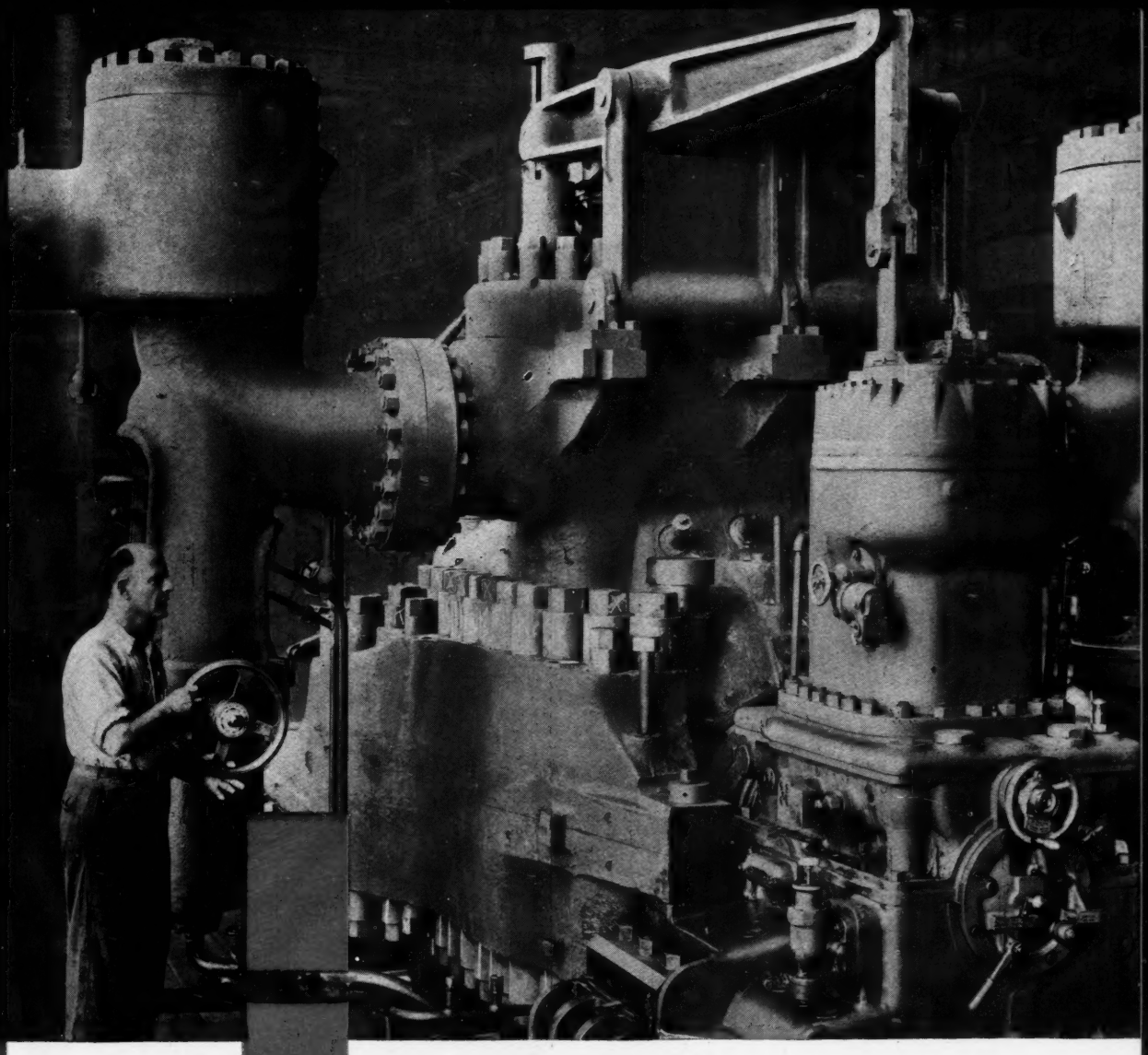
J-50444

Completed turbine generator as it will appear in its attractive, streamlined housing.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Steam Headquarters



HOW CRITICAL ALLOYS WERE SAVED

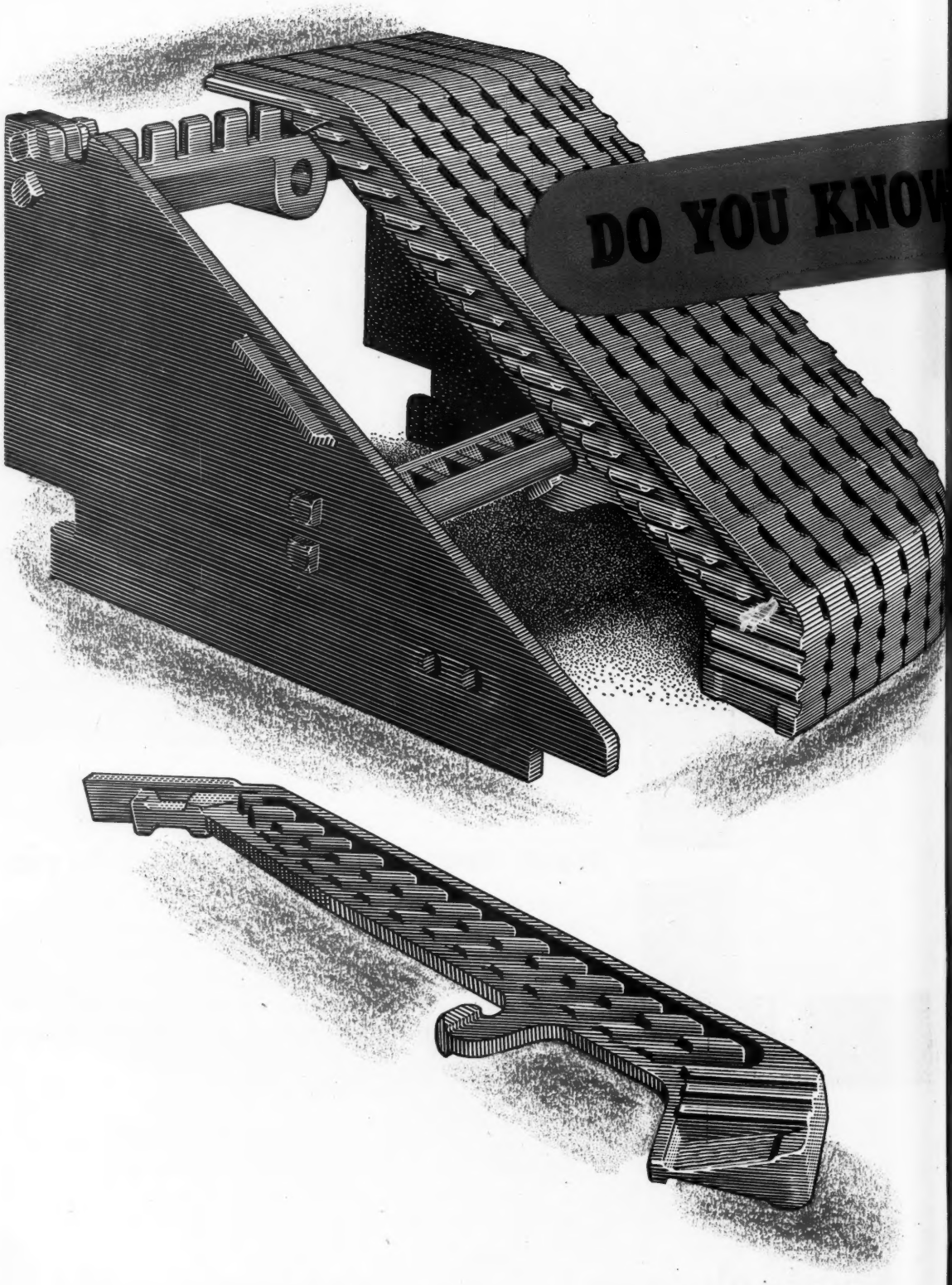
Alloys are scarce—carbon steels more plentiful. So this huge turbine was designed for conservative steam conditions. Low steam pressures required huge steam areas. These conditions, however, resulted in important alloy savings throughout the plant. By keeping steam temperatures within the working limits of carbon steel, turbine parts, super-heaters, valves and piping could be made from this more plentiful metal.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Steam Headquarters

WESTINGHOUSE


DO YOU KNOW

THE IMPORTANT BENEFITS of these

EXTENSION GRATE BARS?

A PROPERLY designed extension grate is essential in a stoker if the fixed carbon is to be burned out of the ash and movement of the ash is to be controlled.

Taylor Stoker's Narrow Hi-Hook Extension Grate Bars, the result of many years development, burn out most of the combustible in the ash, effectively move the ash, and at the same time cut maintenance and replacement costs.

There are six sound reasons for increased efficiency at lowered cost:

- Improved air distribution insures the burning out of fixed carbon.
- Improved locking device—damage at lower end does not release bar.
- Improved ash and clinker movement.
- Easily renewable without the use of special tools.
- Longer life of grate bars.
- Less replacement expense.

Narrow Hi-Hook Extension Grate Bars are responsible, along with many other features, for the efficient operation of Taylor Stokers in generating steam at low cost.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

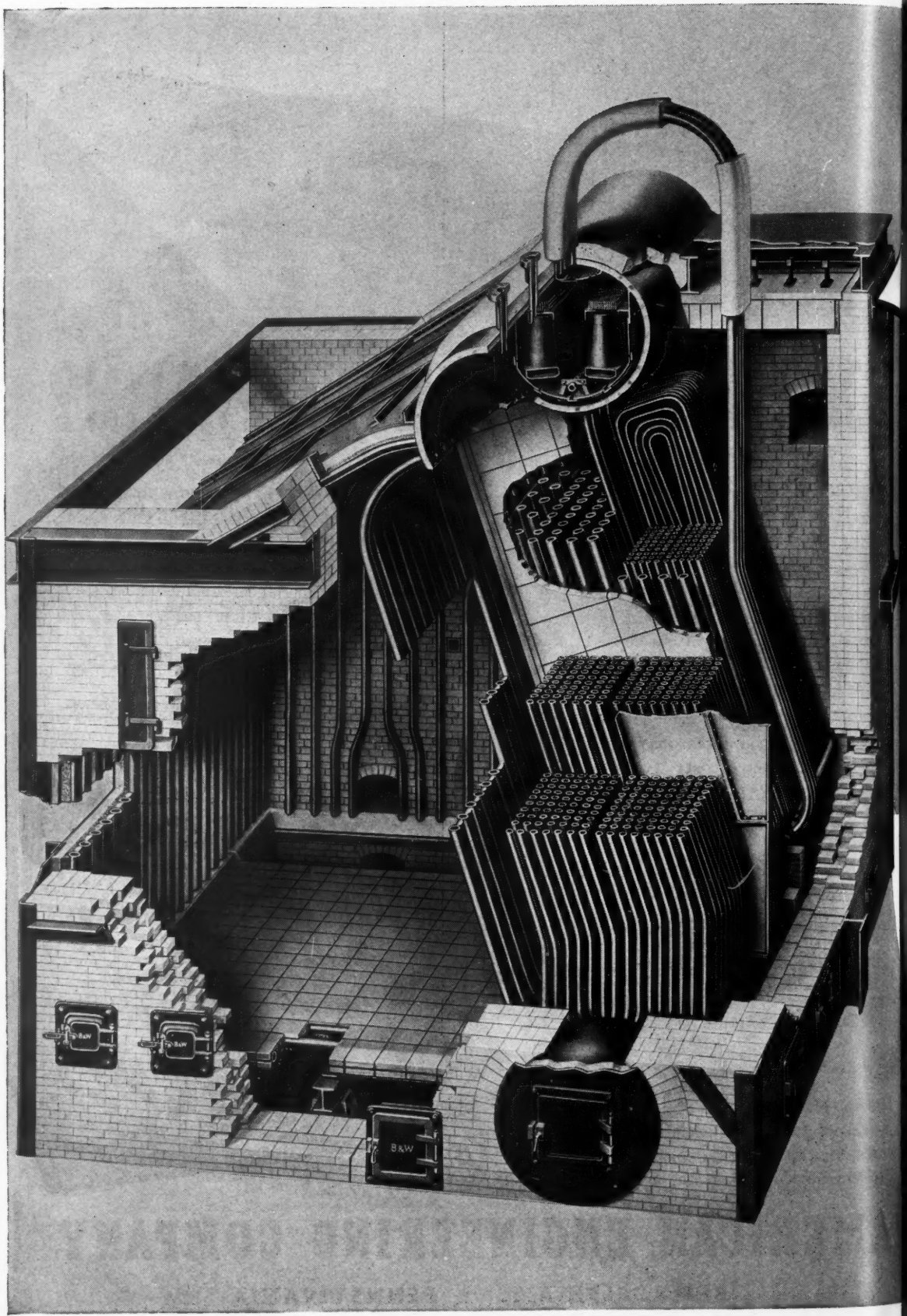
A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

A-E-CO TAYLOR STOKER

AE CO 75th ANNIVERSARY

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA


B&W
B&W
B&W

THEIR DEPENDABILITY IS TWICE PROVED

In steel mills, chemical plants, refineries, ordnance plants, aircraft factories . . . wherever American industries are busy producing weapons of war, Babcock & Wilcox Integral-Furnace Boilers are supplying steam with utmost dependability and efficiency. Thoroughly tried and proved in pre-war services, these boilers are now further demonstrating their high availability for service and consistent reliability in a second set of tough assignments.

Faithful performance has been made certain in these B&W boilers by distinctive design and construction features such as:

1. Water-cooled furnace sidewalls and roof of the same durable stud-tube construction used in large central-station boilers.
2. Deep furnace, fired from one end, provides ample space for complete combustion.
3. Bare metal blocks cover and protect the tubes of the water-cooled furnace floor, provide a surface readily cleared of ash.
4. Self-draining superheater design prevents accumulation of water in the tubes from direct furnace radiation, and a stud-tube wall shields the second and third banks.
5. Tubes of the third bank, which is in the zone of coolest gases, act as downcomers, insuring rapid positive circulation at all loads.

From their additional war-time proving under unprecedented service conditions will come still better B&W Integral-Furnace Boilers to serve post-war industry.

THE BABCOCK & WILCOX CO., 85 LIBERTY STREET, NEW YORK 6, N. Y.

For additional information on B&W Integral-Furnace Boilers, send for Bulletin G-17-A.

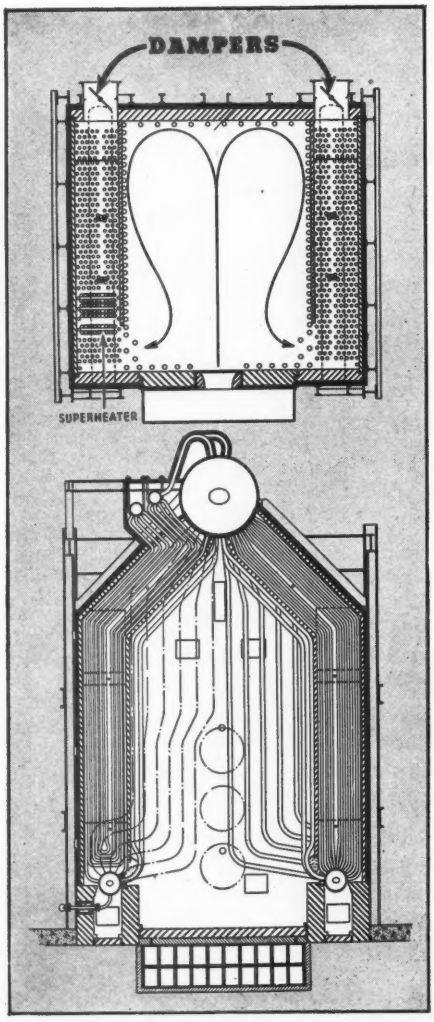
BUY MORE WAR BONDS!

BABCOCK & WILCOX

G266 T

Blazing THE

SUPERHEAT CONTROL in "S-A" Boilers



• Wide range superheat control in "S-A" type boilers is accomplished by placing all superheating surface in one of the twin tube banks. Dampers, placed in the gas outlets, control the proportion of gas flow through this bank to give constant superheat under varying load conditions. Note that dampers are placed in a relatively cool temperature zone.

Foster Wheeler is a Three-Star winner under the U. S. Navy Board of Awards for production.

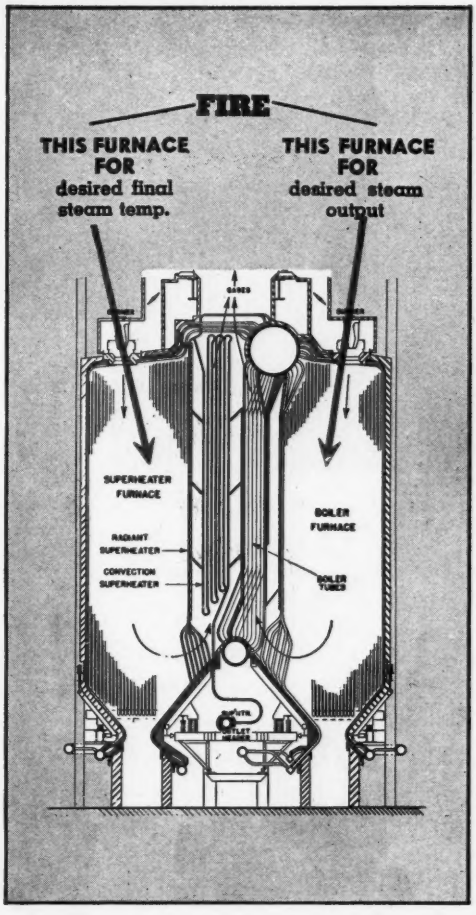
FW FOSTER

ENGINEERING TRAIL

SUPERHEAT CONTROL in Twin Furnaces

● Final steam temperature is determined by rate at which superheater furnace is fired and, therefore, steam temperature can be kept constant or varied at will independent of the quantity of steam produced, rapidity and width of load swings, changes in feedwater temperature or influence of other factors.

The use of the combination radiant and convection superheater gives an additional temperature control which simplifies operation, i.e., with increasing load the superheat increases on convection section and decreases on radiant section. By proper proportioning of the radiant and convection sections, superheat can be held virtually constant from 40% to 100% normal load. Below 40% of load, superheat can still be kept constant by firing superheater furnace slightly harder than boiler furnace.



FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

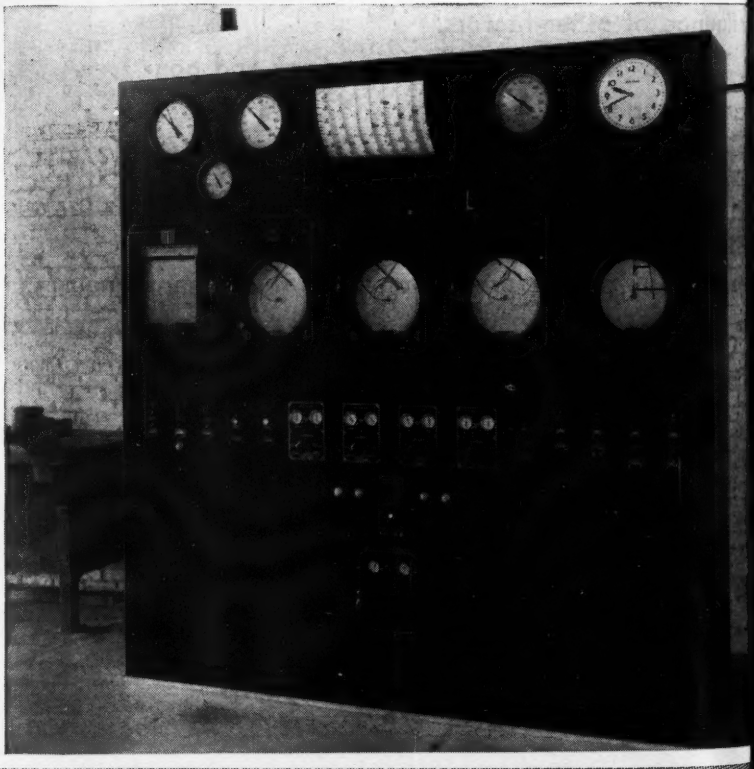
WHEELER FW

ENGINEERED IN

★ ★

This Bailey Boiler Control System for Combustion and Feed Water is engineered to a 450 psi, 120,000 lb. per hr. capacity natural gas fired boiler to secure optimum results in everyday operation.

A 200 psi, 100,000 lb. per hr. capacity stoker fired boiler is operated at a continuous efficiency of 87% by this Bailey Combustion and Feed Water Control System.



BAILEY METERS

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

INSTRUMENTATION Conserves Fuel

★ Maximum fuel conservation is obtained when a boiler plant is operated so that the sum of all controllable heat losses is a minimum. This condition is usually reached when excess air has been reduced to the point where losses from unburned fuel and CO cancel any advantage gained by further reduction of excess air.

Often the amount by which excess air may be reduced is limited by other factors such as refractory deterioration, smoke, and superheat control.

The key to fuel conservation is a correct determination of the optimum excess air value at which each boiler unit should be operated. This value is determined by combustion tests made under actual operating conditions. Once determined, the optimum value is used in setting the Bailey Boiler Meter and from then on fuel economy is simply a matter of vigilance on the part of manual operators or the automatic control system.

This approach makes it possible to conform with war conservation measures through increased efficiency rather than at the sacrifice of product output. It is a procedure by which the experience gained in the most efficient power plants may be put to use in power plants everywhere. It is engineered instrumentation based on the particular requirements of each boiler unit.

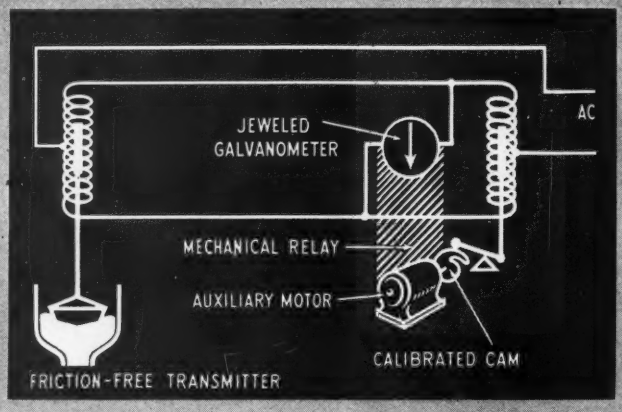
To quickly and efficiently serve Power Engineers in this all important phase of instrumentation, Bailey Engineers are located in over 30 industrial areas throughout the United States and Canada. The Bailey Engineer in your community has a wide background of combustion engineering know-how at his command. It covers combustion tests on thousands of boiler installations including a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you not only with the problem of fuel conservation but also with other problems such as safety, steaming capacity, conservation of man power and continuity of power service.

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

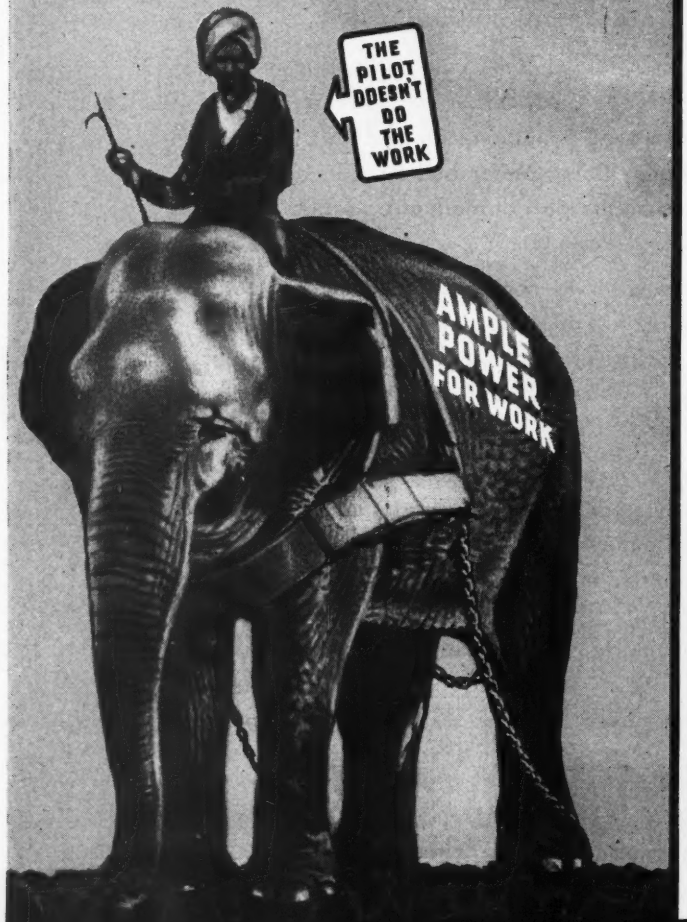
G-20

The Complete Combustion Control System

NTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL



In the Cochrane Flow Meter, the Null or Zero Balance principle is employed, balancing the unknown quantity by adjusting a known quantity of the same kind. A highly sensitive detector is used to determine the point of balance. A friction-free transmitter serves as a pilot for an external motor drive. The motor restores the bridge to balance and operates recording pen, indicating pointer, and integrator. The measuring circuit is relieved of all work.

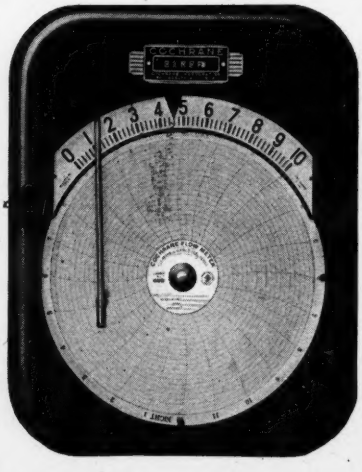


Another Low Maintenance Feature ---the Large Reservoir Pen

The giant glass pen in the Cochrane Flow Meter recorder is another of the many features designed to minimize the amount of attention required in the operation of the meter. The reservoir holds a month's supply of ink. The point is tipped with platinum-iridium, for almost indefinite wear.

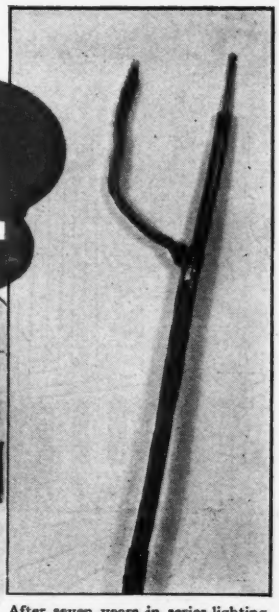
For other Cochrane features, see Cochrane Publication 3010. A copy will be sent upon request.

COCHRANE CORPORATION
3123 N. 17th St., Philadelphia 32, Pa.



COCHRANE FLOW METERS

Seven-year Burial proves superiority of FLAMENOL INSULATED CABLE



After seven years in series-lighting service, buried directly in the ground, this two-conductor, concentric No. 8 Flamenol cable is still as good as new.

FLAMENOL'S LASTING PROPERTIES GIVE LONG, ECONOMICAL SERVICE UNDER SEVERE OPERATING CONDITIONS

More than six years before Pearl Harbor, an Eastern power company made a direct-burial installation of Flamenol cable. After seven years' service, part of it was removed and the insulation was tested—with these results:

Physical Condition: *Excellent*

Insulation Resistance: *336 megohms per 1000 ft*

Tensile Strength: *2560 lb per sq in.*

Elongation: *220 per cent*

Many thousands of feet of Flamenol have since been installed underground for series lighting and 600-volt power circuits. Tests after varied lengths of service show that physical and electrical characteristics of the insulation remain practically unchanged.

Specially developed for severe operating conditions

Years before any rubber shortage, G-E engineers turned to synthetic resins for improved cable insulation. Flamenol, the first such cable to be utilized commercially, proved vastly superior to rubber-insulated cable for service under adverse conditions.

Today, after years of constant development, Flamenol cable offers a wide range of operating advantages:

FLAME RESISTANCE

Does not support combustion.

CORROSION RESISTANCE

Immune to action of oils, acids, alkalies.

AGING

Does not oxidize. Highly resistant to sunlight and weathering.

PHYSICAL PROPERTIES

Tensile strength, 1500 lb per sq in., minimum. Elongation, 100 per cent, minimum.

DIELECTRIC STRENGTH

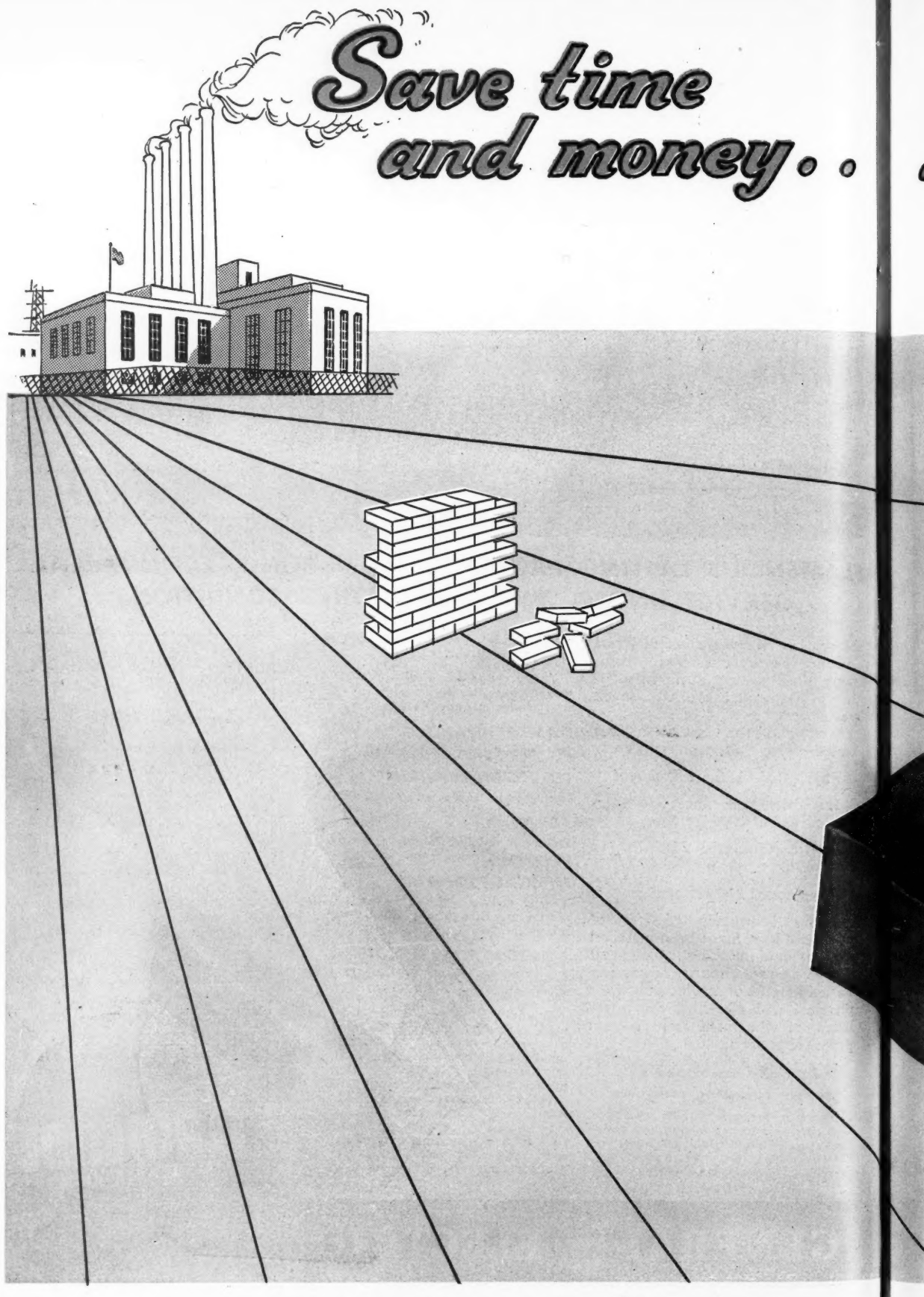
720 volts per mil, retained through severe operating conditions.

In addition to these *time-proved* operating advantages, Flamenol cable is easy and economical to install and maintain. That's why millions of feet of this long-lived cable are used for power and lighting circuits in the chemical, food, textile, printing, oil, mining, steel, automotive, railroad, and other industries. For detailed information on uses, constructions, sizes, etc., write for Leaflet GEA-2733D. *General Electric Company, Schenectady, N. Y.*

7 Extras That Insure EASY INSTALLATION, ECONOMICAL MAINTENANCE

1. SMALL DIAMETER saves space, facilitates wiring.
2. SMOOTH SURFACE assures easy pulling.
3. FREE STRIPPING speeds splicing, avoids nicking conductors.
4. DIFFERENT COLORS simplify circuit tracing.
5. VARIOUS CONSTRUCTIONS to suit special applications.
6. SELF-PROTECTING finish eliminates need for conduit.
7. RETAINS ATTRACTIVENESS makes re-painting unnecessary.

GENERAL ELECTRIC


Save time
and money . .

. . with CRYSTOLON brick

NORTON CRYSTOLON Brick are bringing real savings in time and money to power plant operators. Densely constructed of silicon carbide plus a highly refractory bond and fired at high temperatures these rugged brick will not spall under peak operating conditions. Their dense surface resists slag adhesion and penetration making clinker removal a short, easy operation. CRYSTOLON Brick are unaffected by the corrosive action of coal ash slag.

R-872

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

Norton Longer Lasting Refractories

BULLETS AND BOILER TUBES ARE BOTH ESSENTIAL in winning this war. There never was a war in which power was so vital a factor. To keep boiler tubes up to their top limit of power production is the function of Elliott tube cleaners.

There isn't much time to "baby" tube cleaners these days. They have to stand up under pressure. And the new 1300 Series Elliott Cleaners are doing just that, helped by a revolutionary lubrication system that saves bearings and increases power, plus the toughness imparted by the latest developments in metallurgy and heat treating.

These cleaners are built "stocky" to get around short radius curves, with a strong Elliott universal joint between motor and cutter head. When you want to clean tubes *fast*, and cut out tube cleaning delays, use the Elliott 1300 Series cleaner. Cutter heads and drills for all needs.

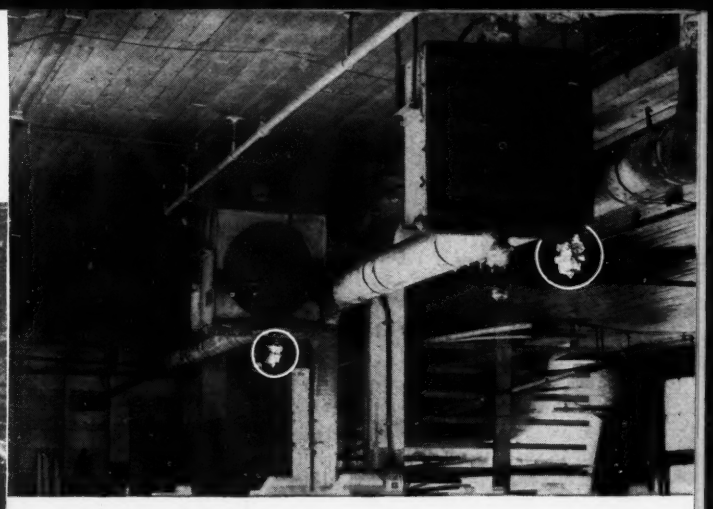
ELLIOTT COMPANY
Tube Cleaner Division, **SPRINGFIELD, OHIO**
DISTRICT OFFICES IN PRINCIPAL CITIES

ELLIOTT

LAGONDA TYPE TUBE CLEANERS

Y-217

10 TONS COAL saved annually by 26 TRAPS



Manufacturer gets big return from small investment in Armstrong traps

FILE 394 We don't know how this particular manufacturer happened to get in touch with the Armstrong distributor in his town, but it could have been something like this:

"Hello . . . hello. Can you come over? We need your help on a steam line modernization job. Our three outdoor wood drying kilns don't heat well in cold weather, and the unit heaters don't work properly. The steam for the kilns and the heating system comes from the steam engine, and even with a back pressure of 7 to 10 lbs. the kilns take from 5 to 5½ hours to heat and at that the temperatures never exceed 110° F."

The Armstrong distributor found that the condensate drainage system, which allowed low pressure returns to blow direct to a closed receiver tank, was inefficient. Fuel consumption averaged 460 tons of coal a year. The distributor's survey indicated installation of 26 No. 200 and 211 Armstrong traps, individually draining unit heaters and providing positive drainage of drying kilns and steam engine.

KILN HEATING TIME CUT ½

The results were highly satisfactory. Back pressure on the steam engine dropped to 3 lbs. and later to 2 lbs. The kilns now required only 2 to 2½ hours to heat, and a temperature of 150° was maintained even on the coldest days. Coal consumption was cut from 460 to 290 tons a year, representing a saving of 37% on fuel alone.

TABLE OF SAVINGS

Fuel loss of various size steam leaks at 100 lbs. steam pressure

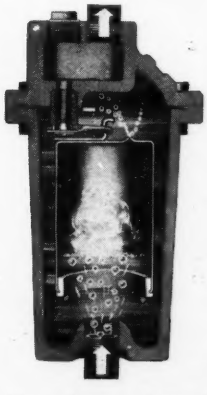
Orifice size	Lbs. steam lost monthly	Coal waste per year	Oil waste per year
1/2"	835,000	334 tons	53,440 gal.
3/8"	470,000	188	30,080
1/4"	210,000	84	13,440
1/8"	52,500	21	3,360
1/16"	13,200	5.3	848
1/32"	3,400	1.4	224

The above table is based on evaporation of 15 lbs. of water per lb. of coal, and that 160 gallons of oil are equivalent to a ton of coal.

Complete trapping gets results in all steam-using industries

The difference in fuel and heating time savings between Armstrong *complete* trapping and condensate drainage by ordinary methods is often enough to pay the cost of Armstrong traps in a short time.

By complete trapping we mean the ability of Armstrong inverted bucket traps to eliminate air . . . pass dirt, sludge and scale ordinarily encountered in steam lines . . . prevent steam loss . . . as well as drain condensate automatically as fast as it forms.



Above: Armstrong bottom inlet-top outlet trap with bucket in closed position.

Side inlet-bottom outlet trap.

Side inlet-side outlet trap.

Patented Free-Floating Valve

The frictionless leverage system and other engineering features of Armstrong traps insure freedom from wire-drawing of the valve and orifice, permit holding tight against vacuum, and insure long life with negligible maintenance. Considering their capacity with hot condensate, Armstrong traps are very small in size and low in cost. The Armstrong Trap Book illustrates standard and special traps, and contains valuable data on trap selection and installation. We'll be glad to send you a copy.

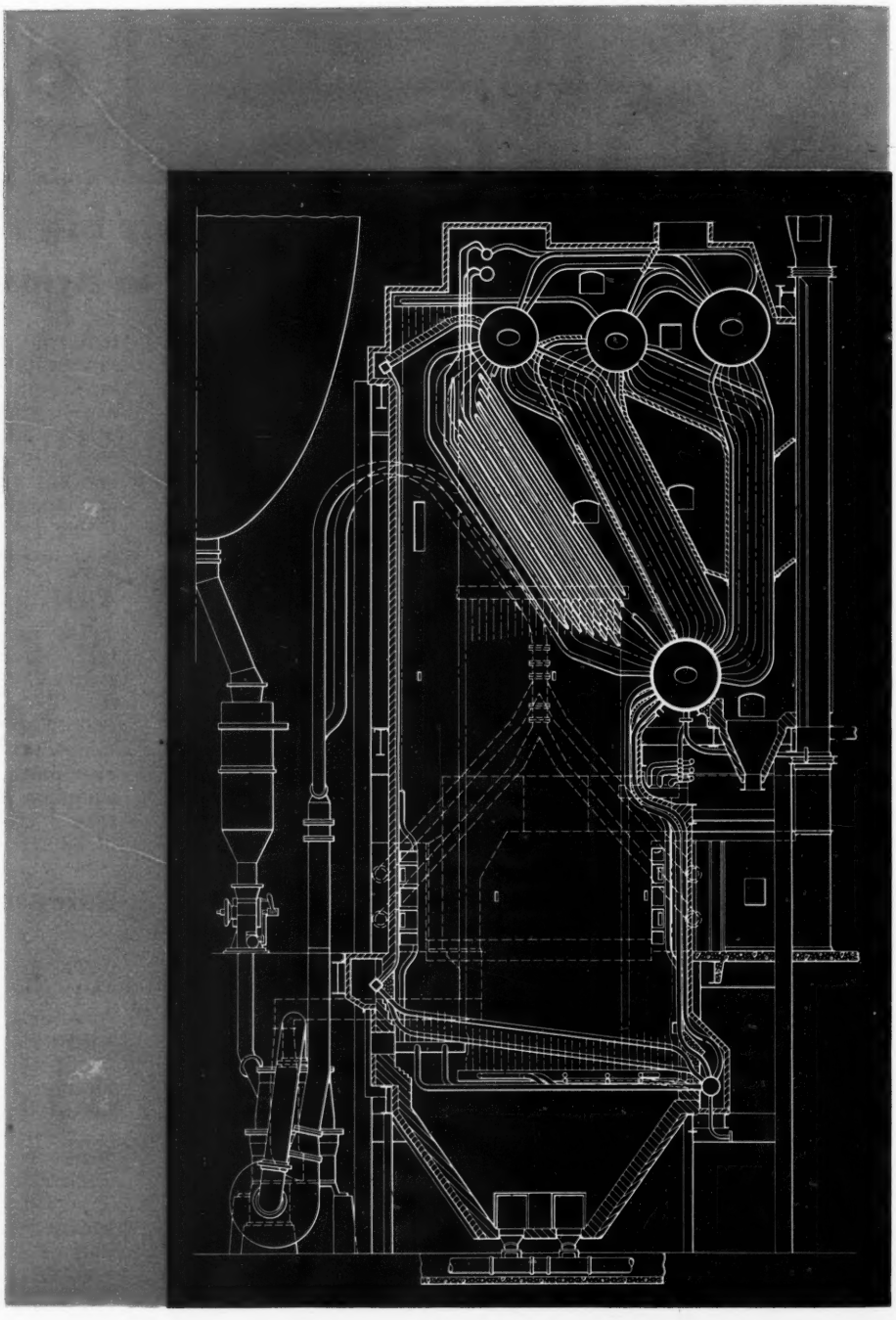
ARMSTRONG MACHINE WORKS
810 Maple St. • Three Rivers, Mich.

ARMSTRONG INVERTED BUCKET STEAM TRAP

Armstrong

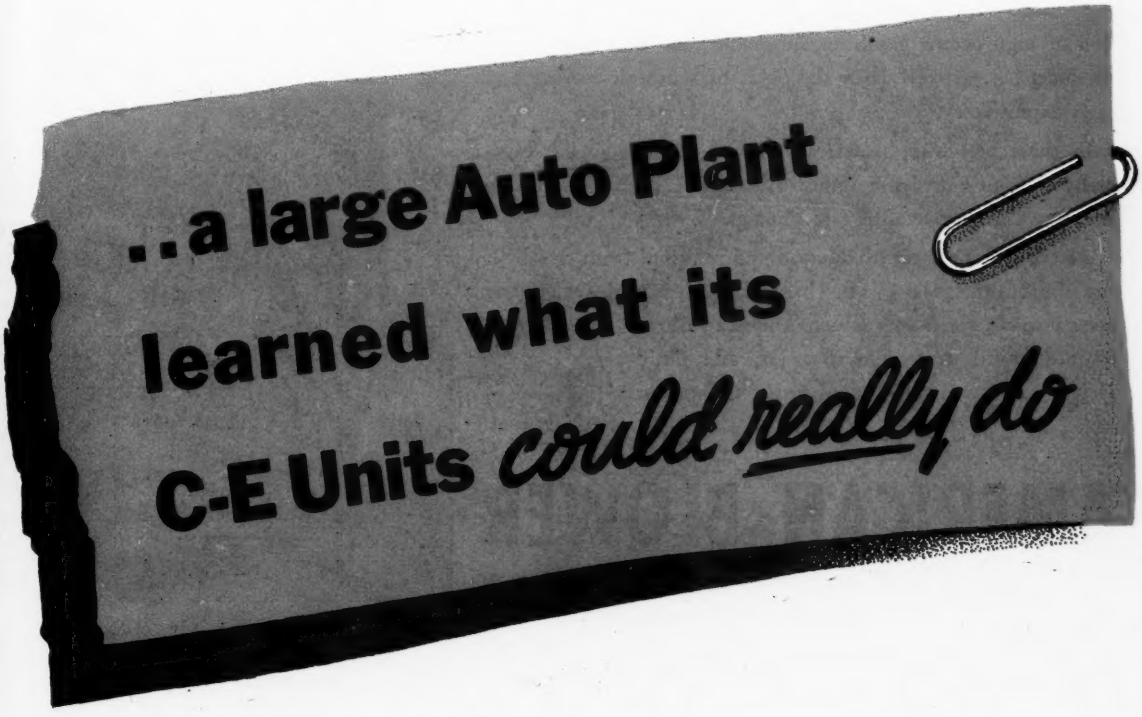
STEAM TRAPS • AIR TRAPS • PURGERS • HUMIDIFIERS

WHEN PEAK LOAD RATING



One of two duplicate C-E Units responsible for the remarkable record related on the opposite page. Capacity — 125,000 lb of steam per hr (maximum continuous). Design Pressure — 700 psi. Total Steam Temperature — 750 F.

BECAME CONTINUOUS DEMAND



In 1937 a large mid-west automobile company installed 2 C-E Pulverized-Fuel-Fired Units in one of its plants. These units were designed to produce, at maximum continuous rating, 125,000 lb of steam per hr with peak ratings up to 170,000 lb per hr for 4 hours. This they did, with complete satisfaction, for more than three years — and then came War.

Rapidly the plant was converted, 100 per cent, to war work. More — more of everything — was the order of the day, including, of course, more steam. How well the C-E Steam Generating Units responded is evidenced by the fact that they were soon *averaging* 170,000 lb of steam per hr *continuously* — and at a monthly efficiency of 84 per cent.

Continuously has added significance for not only had *peak* rating become *continuous* rating but the availability of these units has been better than 98 per cent for the past 3 years — less than 2 per cent forced outage.

Thus the extra values in C-E design and construction are demonstrated again. Such performance repeated in many *war* plants has established the ability of C-E equipment to meet every demand with consistent dependability. You can assure this quality of performance for your *peace time* steam needs — Specify C-E.

A-772

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

Canadian Associates: **COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver**

Progress and Power in the P

All the world knows the tremendous strides made by the Petroleum Industry since Pearl Harbor. Today this far reaching industry is playing a doubly important role in the production of high octane gasolines, lubricants, and other petroleum products . . . as well as in the fields of synthetic rubber and high explosives.

In these activities, American Blower has developed, especially for the Petroleum Industry, a variety of Elevated Temperature Fans for handling red hot gases.

At every step of oil production and refining, from the drilling of oil to the great Public Utilities which furnish the electric energy to the finished product, American Blower mechanical draft fans, blowers, and Fluid Drives are dependably performing important tasks.

MECH. DRAFT · AIR-CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS

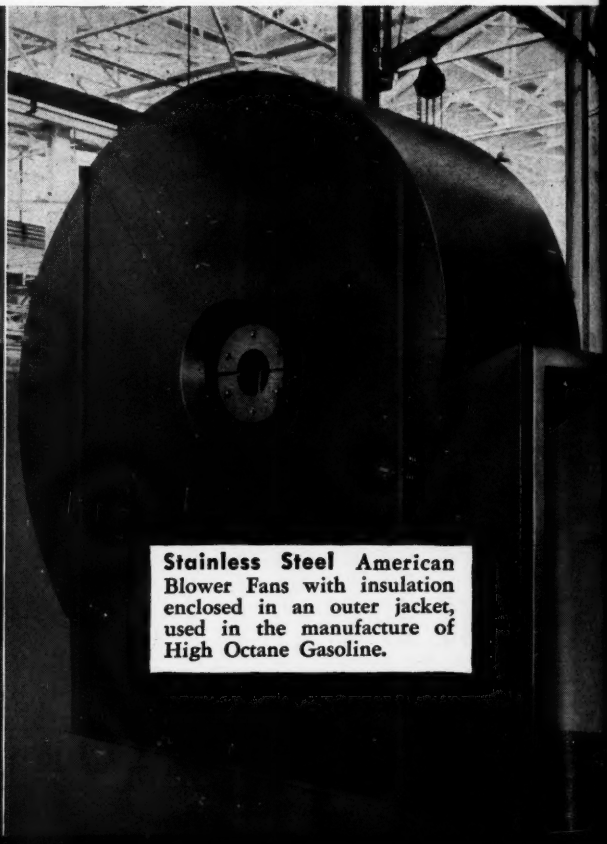
AMERICAN BLOWER

ARMY E NAVY
For excellence in production.

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

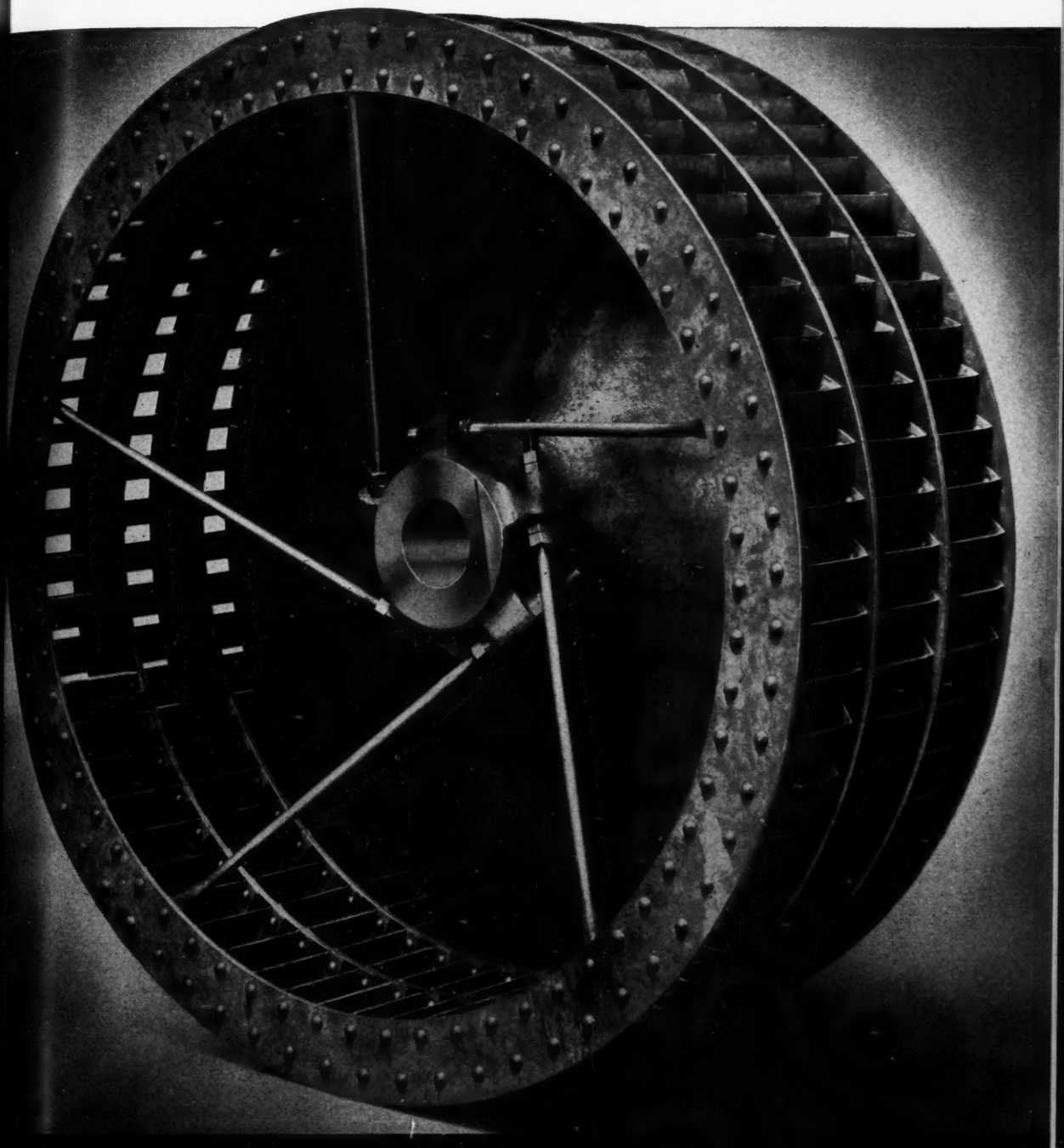
American Blower High Temperature Fan specially designed for circulating hot gases in the manufacture of Butadiene.

Elevated Temperature Blower for process work in the production of Toluene high explosive.



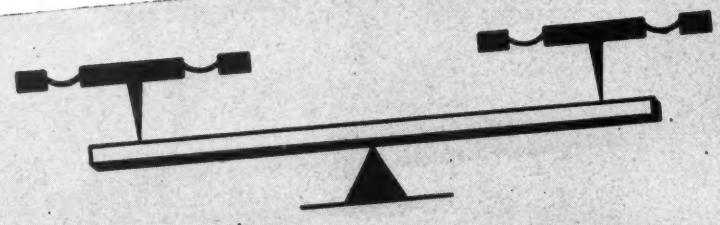
Stainless Steel American Blower Fans with insulation enclosed in an outer jacket, used in the manufacture of High Octane Gasoline.

PETROLEUM INDUSTRY



The wheel of an American Blower Heavy Duty Sirocco Elevated Temperature Fan constructed for maximum volumetric and power efficiency; also for *minimum distortion* and *internal stress*. Reliable wrought *stainless steel shapes* are used in the more highly stressed parts to provide maximum life against *metal creep*. This is the paramount criterion in the design of these *red hot* operating parts.

ACTION AND REACTION MUST BE EQUAL AND OPPOSITE



FORCE BALANCE

PRINCIPLE OF MEASUREMENT AND CONTROL

Recent developments in the application of the Force Balance principle offer some interesting and unique possibilities for the automatic regulation and measurement of flow—pressure—liquid level and temperature in your plant. Write us for details.

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy. • Chicago 47, Illinois

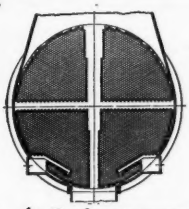
The Smoot Engineering Corp., now a part of the Republic Flow Meters Co., were early pioneers in the application of the Force Balance principle to automatic metering and control equipment. The first Smoot regulators built in 1914 incorporated the Force Balance principle as have all Smoot (now Republic) regulators since that time. It is the recent development in the application of this old principle that are establishing new standards of accuracy and sensitivity in the field of measurement and control.

28 Years of C. H. Wheeler DUAL BANK CONDENSERS

KEEP PACE WITH IMPROVEMENTS IN TURBINE DESIGN

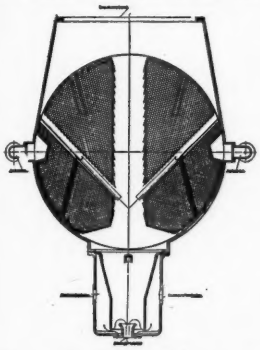
As the Steam Turbine was developed for higher vacuum, C. H. Wheeler Condensers followed the same trend.

1916 **THE FIRST C. H. WHEELER CONDENSER** with which the steam ejector type air pumps were used is shown by this actual installation tube sheet.



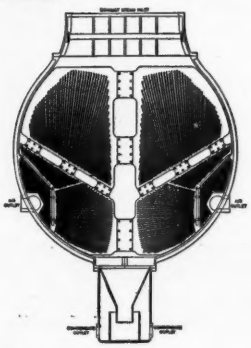
Result: Condensate temperatures within 5° of temperatures corresponding to vacuum.

1923 **IMPROVEMENT:** Wider steam lane and hotter condensate—shown in literature published at that time.



Result: This produced condensate temperature corresponding to temperature of vacuum and the oxygen content was less than 0.03 cc per litre.

1929 **FURTHER IMPROVEMENT:** More open area for entering steam—illustrated in literature published at that time.

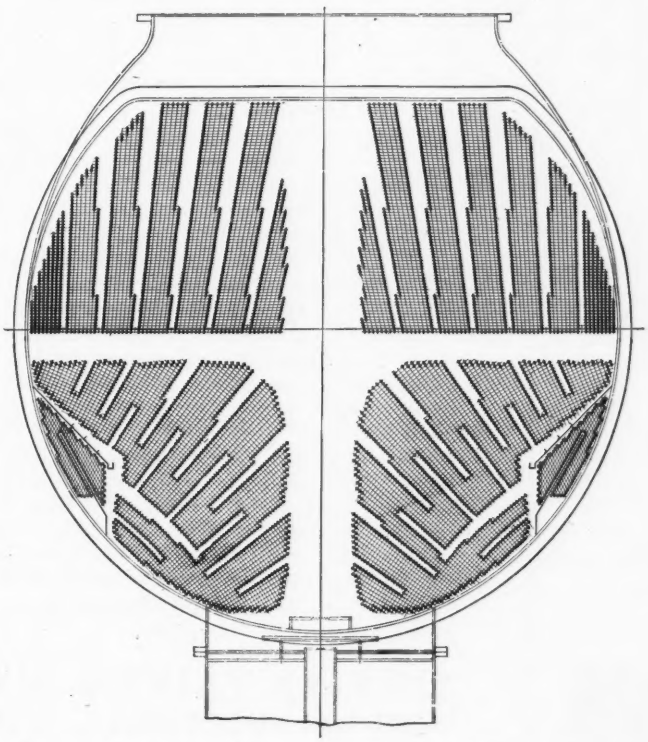


Result: Less pressure drop.

1944

ARMY E NAVY

NOW—Additional steam lanes give deeper penetration for the entering steam!

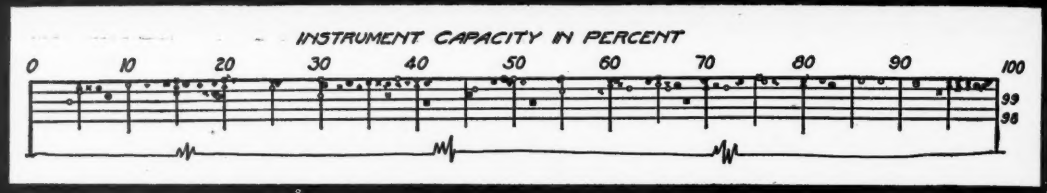


It is evident from the illustrations that the C. H. Wheeler Manufacturing Company has pioneered the development of this highly efficient Dual Bank Condenser.

PRODUCTS: Surface Condensers • Steam Jet Ejectors • Cooling Towers • Deck Machinery

C. H. WHEELER MANUFACTURING CO.

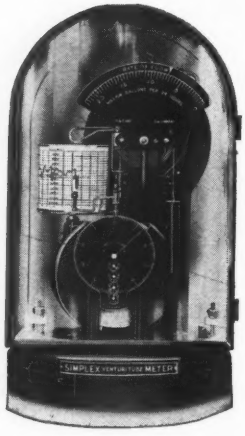
19th ST. and LEHIGH AVE., PHILADELPHIA, PA. *of Philadelphia*



Here is visual proof of the efficiency of Simplex MO Meters taken from Weighed Water and Volumetric tests.

The OVERALL ACCURACY of the SIMPLEX MO METER

AS SHOWN BY WEIGHED WATER and VOLUMETRIC TESTS



The matter of final concern to the user of a flow rate meter is the overall efficiency of the instrument — whether its purpose is to indicate, record, or totalize the flow.

The efficiency of sixteen Simplex MO Meters when tested in place by weighing scales and checked by the volume of standpipes is here illustrated. The data was taken at random from routine records of wide-range tests conducted by the laboratory of Simplex Valve & Meter Co. These accuracies speak for themselves.

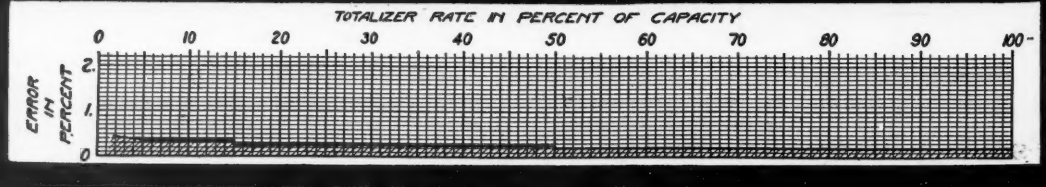
In addition to its inherent accuracy, the Simplex MO Meter operates on a simple trouble-free principle which assures extreme sensitivity over the entire meter range. An applied differential head of 1/8 inch of water or less is sufficient to cause functional operation of this instrument. Any change in the rate of flow through a primary device is instantaneously and accurately recorded on the Simplex Meter Chart.

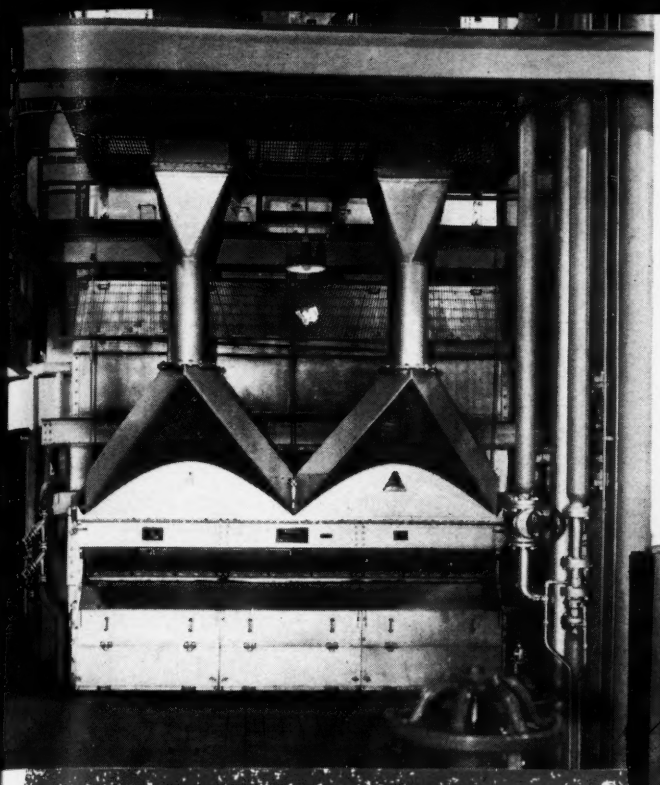
In the unique totalizer design, a frictionless vertical movement of the assembly occurs with flow changes. Constant speed revolution of a friction disc through the variable horizontal speed of a traction roller integrates the rate of flow. The result is highly dependable, accurate totalization of flows over the entire range of the instrument.

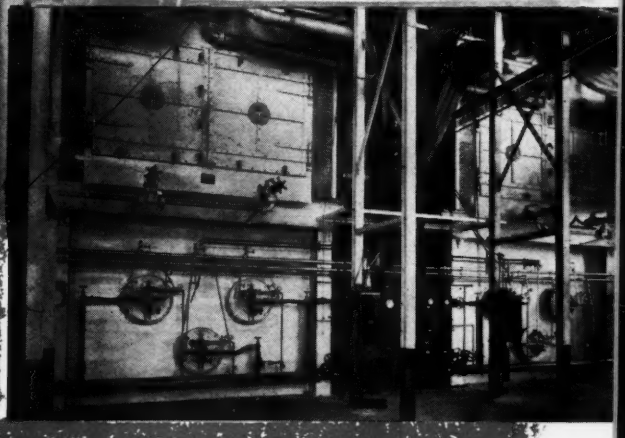
Investigate the exceptional values of the Simplex MO Meter. Write today for Bulletin 300.

SIMPLEX VALVE & METER CO.
6783 UPLAND STREET, PHILA. 42, PA.

An error curve showing totalizer rate in percent of capacity against actual weighed water.







ELECTRIC STEEL HEADERS

. . . improve sectional boiler design

Another of the outstanding features that Springfield has pioneered in water-tube boiler design is the use of electric-furnace cast steel for boiler, water wall, superheater and economizer headers —which gives Springfield boilers a much broader field of application than ordinary sectional header designs.

Flexibility in design is secured at nominal cost by modifying patterns to meet desired conditions, and uniform strength is secured throughout the entire header structure by increasing casting thickness or incorporating reinforcing ribs as required. The casting process also makes possible a wide variety of header designs to assure correct design for each boiler application.

This electric furnace cast steel complies with all construction code requirements. Chemical analysis and physical properties are under careful control and are carefully checked by laboratory tests on each heat. All castings are fully annealed. Carbon steel used for most Springfield boilers under 600 lbs. working pressure tests 72,000 lbs. per sq. in. minimum tensile strength. For higher pressures, alloy steel is used that ranges from 85,000 to 105,000 lbs. tensile strength.

Other advantages: Tougher metal in headers to resist tube rolling and to form tighter and stronger rolled connections. The tensile strength and yield point of Springfield electric steel is 25% greater than the usual forged or wrought steel. No seams or crevices are present to provide starting points for caustic embrittlement or corrosion, and the cast surfaces are corrosion resistant. Pitting or corrosion has never been reported in Springfield headers.

Springfield sectional header boilers are worthy of serious consideration on any modern boiler project.

SPRINGFIELD BOILER COMPANY

1951 E. Capitol Avenue • Springfield, Illinois

SPRINGFIELD

MODERN STEAM GENERATING UNITS

*COLOR..

TIDE WATER LUBRICANIA

DEFINITION: For practical purposes, the color of an oil is expressed as a "number" which is determined by matching the light transmitted through a pre-determined depth of oil with that same light transmitted through numbered and standardized glasses or disks.

EXPLANATION OF TESTS USED: The American Society for Testing Materials have selected two instruments for determining the color of petroleum products. These instruments are:

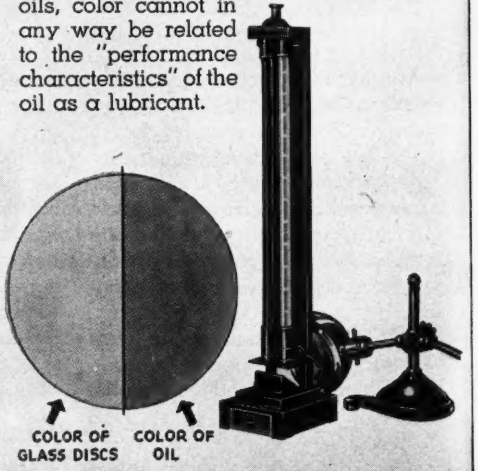
(1) **The Saybolt Chromometer** for making color determinations on the lighter oils.
(2) **The Union Colorimeter** for determining color on the "pale-straw" and darker products.

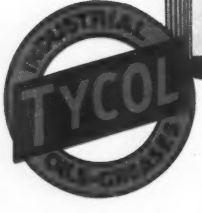
THE SAYBOLT CHROMOMETER consists of two vertical glass tubes. One of these tubes is of plain glass, open at both ends with provision for holding one or two colored glasses or disks at the lower end. The other tube is closed at the lower end with a colorless plate and is provided with a drain cock. This tube is graduated. A mirror reflects light through the oil and the tubes into an optical prism-eye piece for matching the light passing through the oil with the light passing through the disks. The color scale for light oils varies from minus 16 to plus 30.

THE UNION COLORIMETER: In the Union Colorimeter the N. P. A. or A. S. T. M. color of the oil is obtained by matching one of a series of fixed color standards against a sample of oil. The comparison is observed through a circular aperture at the end of a long rectangular box. The color standards are mounted at one end of the box in a vertical magazine which may be moved up and down by means of a knurled hand knob operating a ratchet and gear.

The method used for matching colors on both the Saybolt Chromometer and the Union Colorimeter follow a carefully prescribed procedure outlined under A. S. T. M. Designations D156-38 and D155-39T respectively.

SIGNIFICANCE: Color is of importance in the case of certain light petroleum fractions, particularly products used in dry cleaning or in the textile industry, where the use of colored products might discolor the fabric being treated. The chief significance of color as applied to the darker oils is in the fact that it is a generally accepted index of the uniformity of a given grade or brand. In these oils, color cannot in any way be related to the "performance characteristics" of the oil as a lubricant.





DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

* This is the 8th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

All Tycol oils and greases are subject to rigid tests to control the uniform quality of manufacturing. They are manufactured in a comprehensive line so as to meet every specific operating requirement. It is the combination of the unvarying high quality of Tycol products and the scope of the line that makes possible the unexcelled performance of Tycol lubricants for Industry.

TIDE WATER ASSOCIATED OIL COMPANY

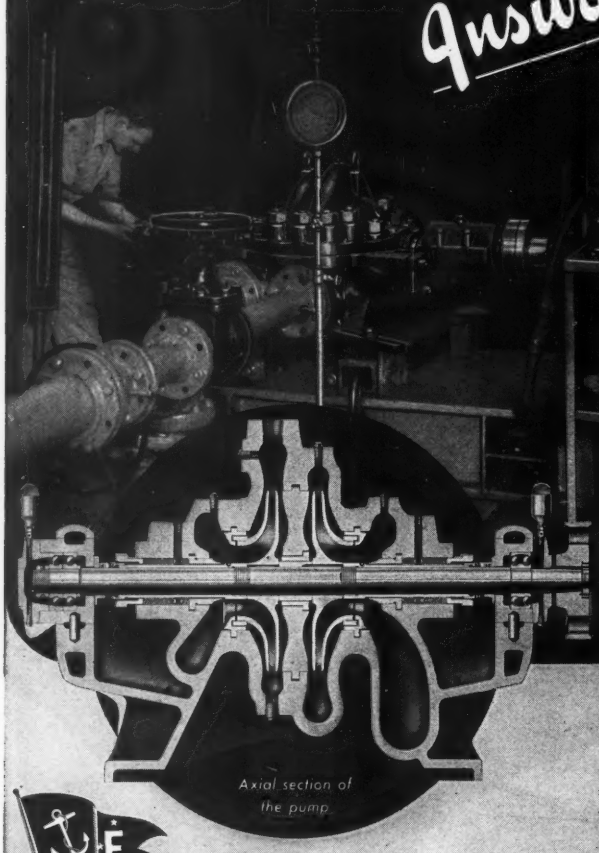
MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

***Principal Branch Offices:* Boston, Philadelphia, Pittsburgh, Charlotte, N. C.**

INDUSTRIAL LUBRICANTS

RIGID INSPECTION AND TESTING — Insure High Quality

Opposed impeller centrifugal pump on test



Axial section of the pump

The highest quality of engineering design and of workmanship has always been the ideal of the De Laval Steam Turbine Company. High grade machines can be produced only by care in selecting and purchasing materials and by the use of specialized equipment, including precision tools, gages, jigs and measuring devices, followed by limit-gage inspection of finished surfaces and by thorough testing of completed units.

The testing here shown of a two-stage De Laval Pump is typical of the routine testing of De Laval centrifugal pumps. The pump is driven by a calibrated motor and accurate readings are made of speed, pressure, delivery and power consumption over the working range. The unit is then dismantled and all working surfaces are again inspected and checked. In some cases a torsion meter is used for determining input.

A similar procedure is followed with De Laval steam turbines, helical and worm gears, centrifugal compressors, and rotary displacement oil pumps.

The testing equipment includes suitable gages and meters for measuring power and fluids of all kinds and at various pressures and temperatures, also plant for generating steam at high pressure and temperature and for producing high vacuum.

M-34

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER, PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS, GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

In the Army it's

LOGISTICS—

In Industry it's

MATERIAL HANDLING

Getting the RIGHT Material to the RIGHT Place at the RIGHT Time!

• In the army the supply lines are ships, trains, trucks and planes. In industry, they are conveyors and elevators, engineered into efficient material handling systems.

The development of such systems is a job at which Stephens-Adamson has specialized for 42 years. This broad design and manufacturing experience is at your service now—to help you secure a system that will assure fast, safe and economical conveying and elevating of any kind of bulk materials. For the solution to your present or anticipated material handling problems, call on S-A.

STEPHEN S-A ADAMSON MFG. CO.

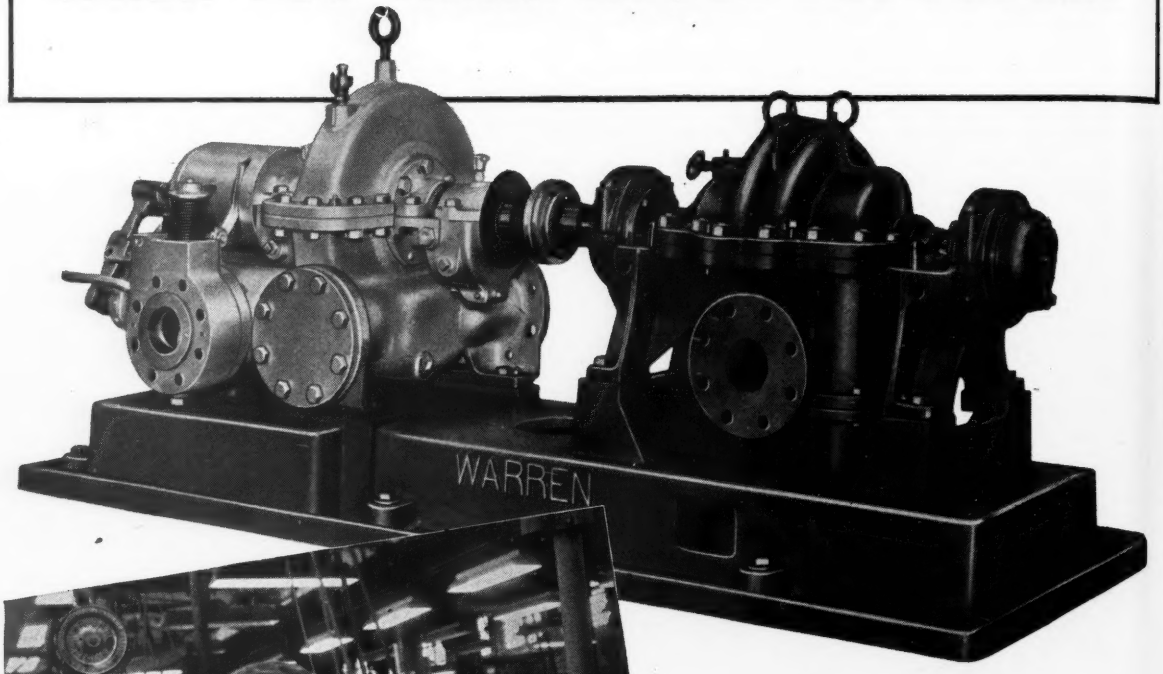
515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

Here's a Warren Pump to think about

WHEN YOU THINK ABOUT THE FUTURE



Meet Archie Albert, highly skilled Warren employee . . . and foreman of the Warren Engine and Small Turret Lathe Department. Archie's been with Warren for 21 years . . . is very proud of Warren pumps and their reputation for reliable, economical performance. He's proud, also, as all of us are — of the Warren Army-Navy "E" Award.

This Warren Centrifugal Pump is being made for commercial purposes in limited quantities, now

Warren Two Stage Volute Centrifugal Pumps have been carrying their share of the load in the war effort because of their unusual stamina, low maintenance cost and reserve capacity. They are well worth considering *now* for post-war work.

One of the design features concerning these Warren Pumps which has a direct bearing on their low maintenance cost is the fact that they are *hydraulically balanced*. Stages are arranged so that one stuffing box is under suction pressure and the other is subject to only the first stage pressure. A separate interstage loop permits efficient connection between the two stages.

Other features include, liberal clearances between impeller and case rings . . . extra-heavy shafts . . . over-size bearings . . . carefully proportioned liquid passages. Write for Bulletin 229.

ARMY E NAVY

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

"I want A FLEXIBLE GASKET TO WITHSTAND 2000° F." said the airplane part maker

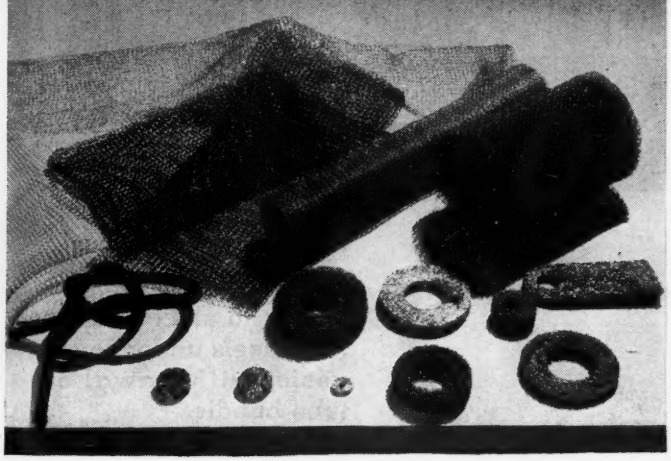
"I want A FEEDWATER CLEANER THAT CORROSION WON'T CRIPPLE" said the railway mechanical engineer

"I want A FINE TUBE GRID THAT WON'T SAG" said the electronic tube maker

"I want A LASTING WICK FOR AIRPLANE HEATERS" said the cabin heater maker

All found their answer in

KNIT METAL MESH



"I want A BETTER AIR FILTER MEDIUM" said the filter manufacturer

"I want A FLEXIBLE STRAP THAT WON'T JIGGLE LOOSE" said the magneto maker

Knit metal mesh has provided the answer to a lot of tough problems. Perhaps it's the answer to one of *your* problems, too.

The special *linked loop* design assures flexibility, high resistance to breakage, and bias strength.

The fabric holds together even when made of very fine wire (.0045" diameter) and with as few as 4 or 5 openings to the inch. It can be compressed lightly for air, liquid or gas filters... tightly for gaskets.

In applications requiring extra strength, toughness, resistance to high temperatures, corrosion resistance, and other specialized properties, INCO Nickel Alloys are used.

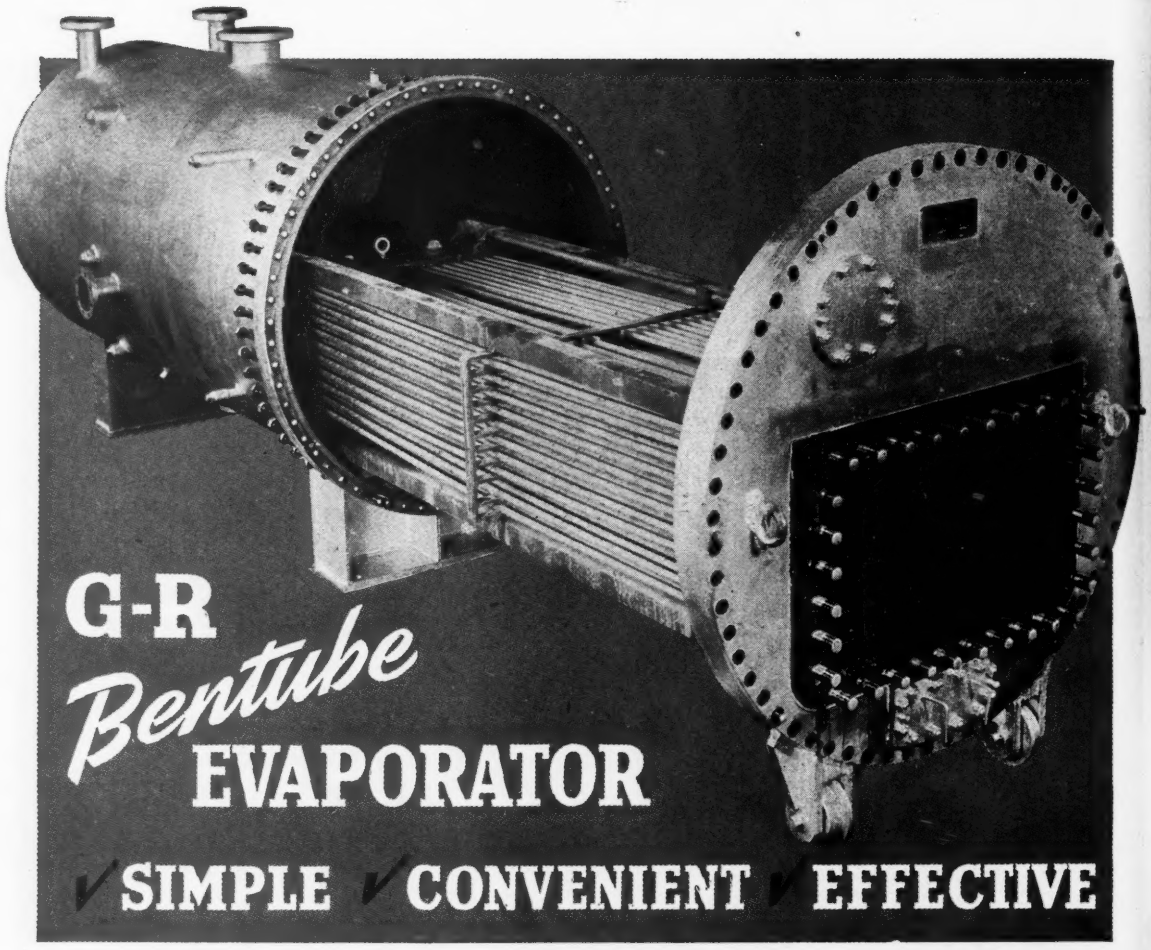
Thus, Inconel knit mesh is used for airplane exhaust manifold gaskets that must retain flexible strength at 1500° F., and for capillary wicks in airplane cabin heating units. Pure Nickel is used in a design that prevents sagging of fine mesh electronic tube grids.

Rustless, corrosion-resistant knit Monel pads are used to filter grit and scale from locomotive feedwater before it is pumped back into the boiler. The Monel mesh made from .006" wire, permits free flow of the water as there is 96% free space... 15,000 square inches of filtering area in a 14" x 20" pad. The pads are readily cleaned every four or five weeks in Oakite and Soda Ash Solution.

For further information, write direct to Metal Textile Corporation, Orange, N. J., makers of knit metal mesh, or to: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

INCO NICKEL ALLOYS

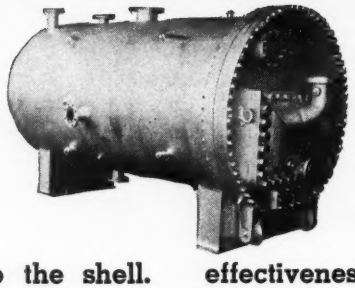
MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • *Sheet... Strip... Rod... Tubing... Wire... Castings*



G-R *Bentube* EVAPORATOR

✓SIMPLE ✓CONVENIENT ✓EFFECTIVE

The location of connections is one instance of the convenience and simplicity of the G-R Type R Bentube Evaporator . . . note that steam head, steam connection, and drain connections are all external to the shell.



Other instances . . . no bolted joints or piping within the shell . . . forward tube sheet serves as removable shell cover . . . withdrawal of tube sheet with tube bundle gives full end access to shell interior . . . wheels under cover assist withdrawal of tube bundle.

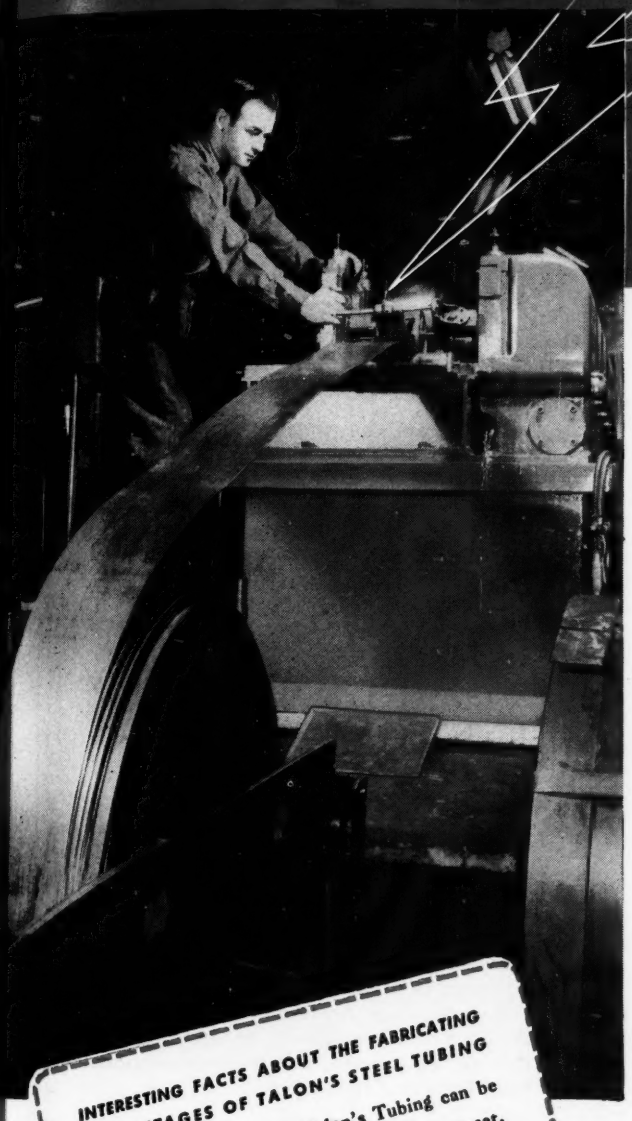
G-R Bentube Evaporator effectiveness . . . wherever pure water is required from any source of raw water supply . . . has been proven in more than 3000 stationary and marine installations.

THE GRISCOM-RUSSELL CO. • 285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Photograph—Operator checks position of strip as it enters forming rolls. In a matter of seconds, it will emerge at the other end as a welded piece of uniform Talon's Tubing.



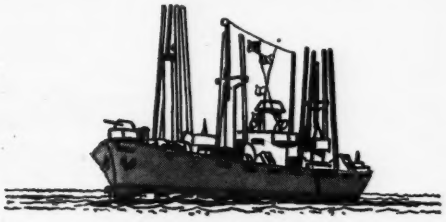
Uniformity of TALON'S Electric Welded Tubing Assured By Careful Selection of Strip Steel

● In the manufacture of Talon's Electric Welded Steel Tubing, coiled, flat stock feeds continuously through forming rolls which shape the strip into a round. Then the butted edges pass under the electric resistance welding unit to form a continuous tube wall.

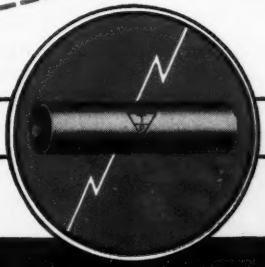
Careful selection of strip assures correct wall thickness, concentricity, and accurate size in the finished tubing. Talon checks each coil for accuracy of gauge and width and condition of surface. The analysis, hardness, and microstructure of the steel are also checked at regular intervals. That is why Talon's Tubing will meet the requirements of your particular application. Your inquiries will receive immediate and careful attention.

INTERESTING FACTS ABOUT THE FABRICATING ADVANTAGES OF TALON'S STEEL TUBING

Change of Section . . . Talon's Tubing can be beaded, expanded, swaged, spun, flanged, upset, grooved, rolled, fluted, flattened, tapered, and otherwise changed in cross-section to meet an endless variety of design requirements.



Talon's Tubing is equal to the tough jobs for which it is used. It is dependable in our ocean-going vessels where long tie-ups for tube replacements must be avoided as much as possible. And remember, Talon's rigid inspection assures this long tube life and less maintenance.



PRESSURE **MECHANICAL**

TALON . . INC.

STEEL TUBE DIVISION OIL CITY, PENNA.

Now Ready...

A Bigger Plant

A Bigger Reservoir of Skill

All discussion of post-war planning makes one fact sharply clear. The world-wide call for Diesel power after hostilities cease will be tremendous —for new enterprises, for rebuilding and because of obsolescence.

The Busch-Sulzer organization will be well equipped to play its part in the world rebuilding program. Since America entered the war our facilities have been greatly expanded and, within the last 18 months, our trained personnel has been increased by 50 percent.

At present we are working 'round the clock on Navy ammunition hoists, Diesel engines for minesweepers, net tenders, ocean-going tugs, U. S. Maritime Commission ocean-going cargo ships and smaller vessels and stationary engines for high priorities only.

When the war is won, work can begin at once upon peacetime projects without long delays for retooling or training. Busch-Sulzer Diesel engines, in unit sizes from 450 BHP upwards, offer a wide range of speeds for different classes of service or drive. They are noted for their low fuel consumption, reliability and long life.

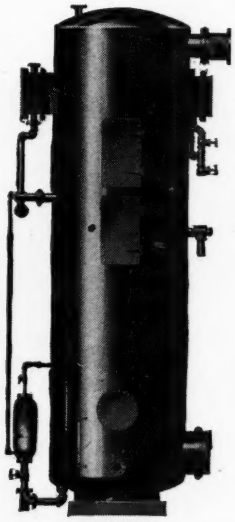
BUSCH-SULZER
ST. LOUIS

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY
SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

DEGASIFICATION OF WATER

OXYGEN *from* BOILER FEED WATER (*Tray Type*)



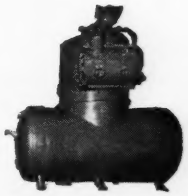
AMMONIA DEGASIFIER

THE removal of gases such as oxygen, carbon dioxide, hydrogen sulphide and ammonia, has been necessary in order to prevent deterioration of piping and auxiliary equipment in power plants, as well as in industrial processes. In addition to this, many processes require the complete removal of oxygen and carbon dioxide for most effective operation.

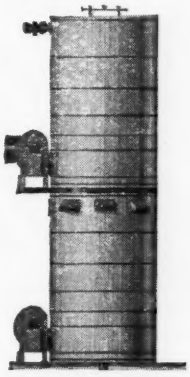
Cochrane Corporation has supplied degasification units of all types to serve the demands of industry and removal of all of these gases. Equipment for removal of oxygen and carbon dioxide from process water at temperatures as low as 34° has been supplied for capacities well over 90,000 GPM.

For the boiler plant, deaerators are available in either the tray or atomizing type for removing oxygen and carbon dioxide. Where carbon dioxide is to be removed from process water alone this can be done under atmospheric pressure by the use of a Cochrane decarbonator.

All of these devices and their applications are illustrated and described in Cochrane's new publication "DEGASIFICATION OF WATER."



OXYGEN *from* BOILER FEED WATER (*Atomizing Type*)



HYDROGEN SULPHIDE DEGASIFIER

COCHRANE CORPORATION

3123 N. 17th STREET PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

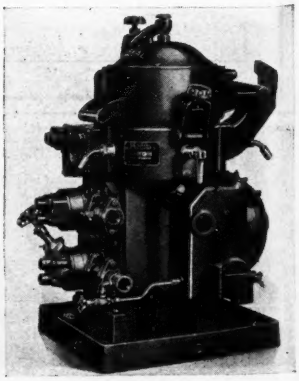
MEANS POWER WHEN IT'S NEEDED

BEARINGS of turbines and Diesel engines, working long hours under full load, need all the protection that high-grade lubricants can give. But even the best oil cannot give this protection unless it is continuously kept free from all the various types of impurities with which oils inevitably become contaminated in service.

The De Laval Oil Purifier keeps oil clean — continuously and unfailingly — instantaneously removing by centrifugal force the various materials that cause oil to lose its lubricating ability. Thus, De Laval purification enables oil to provide a maximum of protection to moving parts and permits the oil to be safely used over long periods.

There is a De Laval Oil Purifier and system for every size and type of prime mover. In writing for further details please state your particular problem.

Bowls of the De Laval Oil Purifiers are of the "constant efficiency" type —the degree of purification is not affected by the removed sediment, which accumulates outside of the zone of separation.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York, 6 427 Randolph St., Chicago, 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco, 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

De Laval OIL PURIFIERS

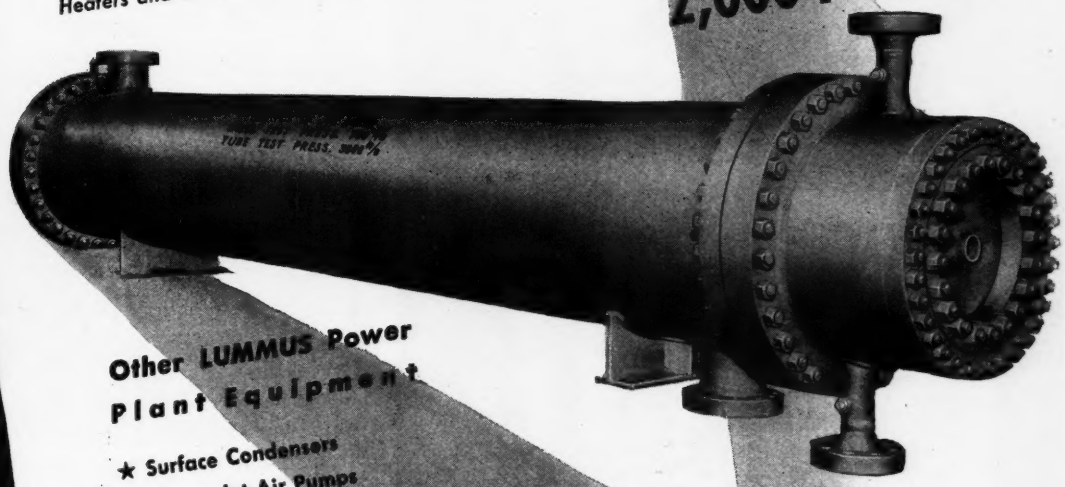
FOR LUBRICATING AND FUEL OIL

Feed water heater

FOR OPERATING PRESSURE UP TO 2,000 POUNDS

HIGHER pressures, with resulting economies, are very much in the post-war picture for power plant heat exchanger equipment. In line with this trend to higher pressures, Lummus is producing Feed Water Heaters and Boiler Blowdown Heat Exchangers for operating pressures up to 2,000 pounds per square inch. This equipment incorporates the Lummus (patented) Multilok closure, a distinct advance in high pressure design.

Write for data on Lummus High Pressure Feed Water Heaters and Boiler Blowdown Heat Exchangers.



Other LUMMUS Power Plant Equipment

- ★ Surface Condensers
- ★ Steam Jet Air Pumps
- ★ Bleeder Heaters
- ★ Boiler Blowdown Heat Exchangers
- ★ Evaporators
- ★ Fuel Oil Heaters
- ★ Lubricating Oil Coolers

LUMMUS

420 LEXINGTON AVE., NEW YORK 17, N. Y.

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make SHAFTS Last Longer . . .

The Allis-Chalmers "Electrifugal" Pump is a unit-designed pump . . . with both impeller and motor mounted on one shaft and in one frame. The next time you need new pumps . . . look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps . . . the "Electrifugal" . . . and all types for every purpose.

WHERE YOU HAVE an Allis-Chalmers "Electrifugal" Pump . . . shaft and rotor pictured at left . . . you don't have an alignment problem—because *both* impeller and rotor are mounted on *one* shaft.

However, many pumps in use today are coupled to a separate motor, and how well the two are aligned has a lot to do with how long the shaft lasts . . . and the pump and coupling too . . . because misalignment starts all three fighting each other!

Here are a few tips which will help you get longer life out of pump shafts:

▶ See that pump and motor coupling flanges are parallel . . . both vertically and axially . . . and that they are kept that way!

▶ If misalignment recurs frequently, check foundations, piping, bolted connections.

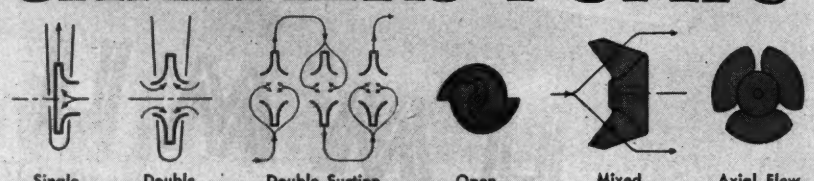
▶ In the case of boiler feed or other pumps which reach high operating temperatures, be sure that alignment of motor and pump is checked after *both* have been operating. Otherwise they might develop misalignment from unequal expansion.

▶ If you haven't done so already, send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". Contains *no* advertising. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN. A 1707

Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.

ALLIS-CHALMERS PUMPS

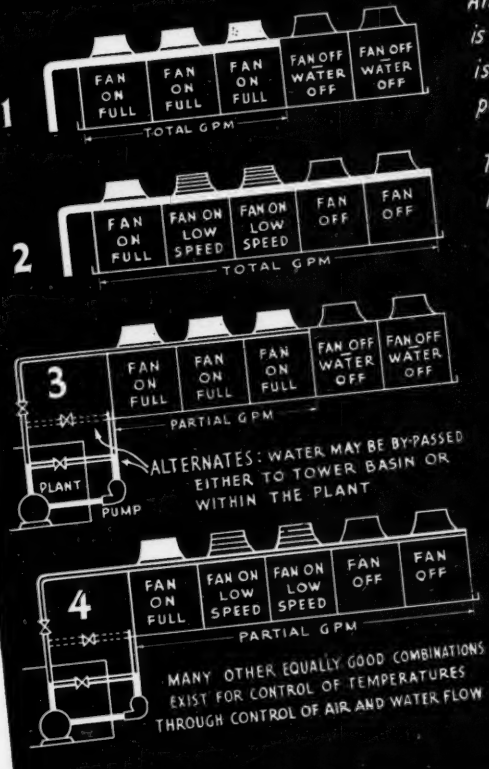
Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



Cooling Tower DOs and DON'Ts
-by MARLEY (No. 1 of a series)

COLD-WEATHER OPERATION

Trouble-free cold-weather operation can be had with modern cooling towers by proper control and maintenance of air and water temperatures within the tower. Water temperatures in all types of towers can be regulated by (a) utilizing only a portion of the tower, (b) by-passing some of the water, or (c) simply throttling the quantity.



Air flow, which affects internal air temperatures, is difficult to control in natural draft towers but is relatively simple with mechanical draft, particularly if fans have 2-speed motors.

To maintain required temperatures, any of these methods, or a combination, may be used:

1. Circulate all the water over only a portion of the tower, shutting down the remainder completely.

2. Circulate all the water over the entire tower with all fans idle or any combination with fans at high speed, low speed or idle.

3. By-pass some of the water and shut down some sections of the tower completely.

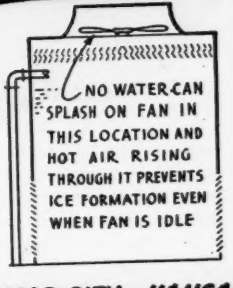
4. By-pass some of the water and circulate the rest either over the entire tower or only some sections of it, with fans variously set at full speed, low speed or idle.

Except in the case of poorly designed towers, good operating practice can avoid "icing" troubles. But should ice have to be removed, thaw it by raising air-and-water temperatures, preferably in one section at a time. If done with hot water or a steam hose, start at top and work down. Induced draft towers can be de-iced by leaving water run and (a) reversing fan rotation if motor and drive permit, or (b) stopping each fan and covering it.

MARLEY COOLING TOWERS

14-A

DO YOU KNOW — that Marley led in developing and advocating the induced draft tower largely because of its all-around operating advantages. Cold-weather features include: 1. Effective performance by natural draft, with fans idle. 2. Only *hot* air passes through fans, keeping them free of ice.



THE MARLEY COMPANY, INC. · KANSAS CITY · KANSAS

Heating 3200 Gallons of Juice from 70° to 210° *in 7 minutes flat*

KEEPING up with the "tomato season" is a big job for men and equipment—for a ripe tomato can't wait.

Here at the Francis C. Stokes Co., cannery at Vincentown, N. J., four 1000 gal. cookers present a really difficult trapping problem.

However, a single little 2 inch Yarway Trap on the 2 inch double heating coils of each unit keeps lines free of condensate, and permits bringing the temperature of 800 gallons of juice from 70° to 210° *in seven minutes.* These traps have been in service 4 seasons, giving uninterrupted performance—having replaced other traps unsuitable for this continuous cooking work.

What are your trapping problems? Install a Yarway Impulse Trap or two and let them prove their merits. See how its *small size* saves space. How its *light weight and straight through piping* make installation *easy.* How its *only one moving part,* and its rugged *bar-stock construction,* cut maintenance costs. Then, too, there is *no need to change valve or seat for widely varying pressures.*

A nearby Mill Supply Dealer handles Yarway Traps and will be glad to serve you. Or write for Catalog T-1738.

YARNALL-WARING COMPANY, 114 Mermaid Ave., Phila. 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

New Materials and Future Designs

By R. C. BERGVALL

ALL OF US like to try to peer into the future and with your industry it is particularly essential to do so, because your investments and planning must be done on a 20 to 25-yr basis, in contrast to industries like chemicals where they know a process is likely to be outmoded in 3 to 5 yr.

Electrical manufacturers use a wider range of materials and demand more from these materials than any other manufacturing industry. My company's material list which is probably quite typical, covers some 8000 to 10,000 different types of materials obtained from all parts of the world. This almost necessitated our becoming military experts at the time Japan was making her rapid push to the South. We had to plan on the basis that most of our supplies of tin, mica and shellac were likely to be lost, and we set out to develop new materials to take their places.

Fortunately, we did not finally lose our mica and shellac supplies except for shipping difficulties, and it was possible to curtail tin requirements to stay within remaining supply sources. Such good results were obtained from the strenuous efforts put forth during the emergency that I sometimes feel we should find some way in normal peace times to create an artificial emergency to stimulate thinking towards new materials and radically new methods of approach.

As more and more synthetic materials are used, manufacturing problems naturally should be expected to become simpler, and would, except for one factor—we properly demand more service from these new materials, which means holding them to exceedingly close control limits. The trend is toward manufacturing operations, and instead of being controlled by the old-type foremen, these operations will be controlled by Ph.D.'s working mass spectrometers. Maybe this is extreme, for ordinary folks seem to quickly grasp the operation of such new tools and our military services are creating a vast reservoir for the future of men trained in handling the new military devices.

The use of a mass spectrometer for controlling the quality of materials is not as far-fetched as it may seem. At first thought, this may seem like a scientist's laboratory plaything, but it will have an important part in the manufacture of some of the new synthetic rubbers and high test gasolines, because results are obtained instantly in contrast with the hours taken by the conventional methods of chemical analysis. With modern plants operating on the continuous flow plan, thousands of tons of improper products could be made before any off-color product was detected by the older methods. We may reasonably expect that the introduction of the mass spectrometer to closely control other types of manufacturing processes will in the future give us new and more effective materials. It could undoubtedly be adopted for checking combustion in your plants, but the expense as against present methods is hardly warranted.

The expansion of our airplane industry has emphasized the possibilities inherent in the use of light-weight materials and construction. This influence is bound to be reflected in our ordinary products and we may look forward to what might be called a "light weight age." This may influence the design of everything, from beds, which are now too heavy for the housewife to lift up when straightening the carpet, to turbine generators.

Much has already been done in the direction of reducing weight, and I have been greatly impressed by the results obtained from a newly-developed material, high-permeability silicon iron known as Hipersil.

The new iron, because its grains oriented in a longitudinal direction, can carry up to one-third more flux than conventional, random-oriented iron. This has made much smaller and lighter transformers possible.

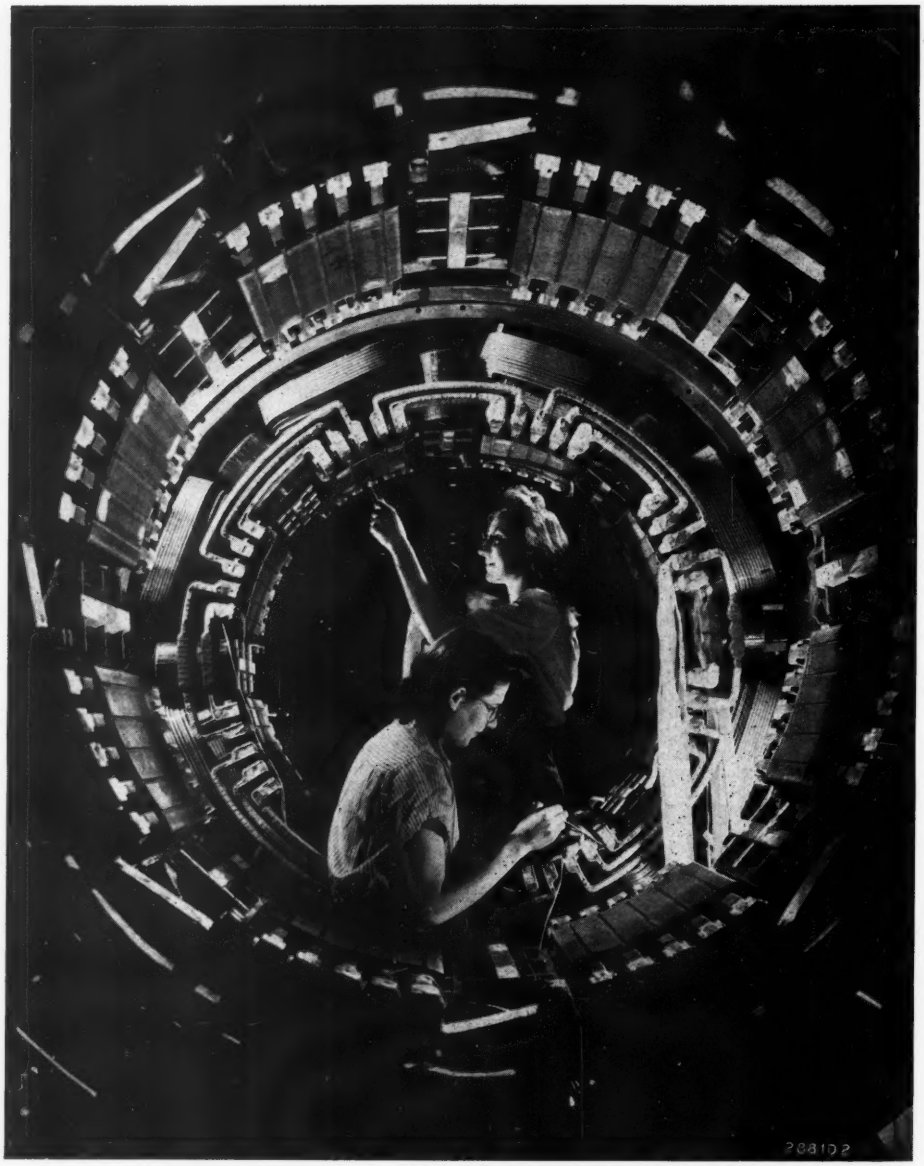
All this sounds fine when one listens to the presentation of a purely technical paper on the subject, but back of the initial production and reduction to practice of an entirely new material like this, are problems like changing over a factory to new methods of making transformers. Along with that, the high cost of the new material had to be accepted, with the expectation that the steel-making methods which were also involved could, by volume production of the new iron, bring costs to acceptable figures. To bring these things about, large financial risks have to be taken and that is necessary every time a new material is going to be introduced on a large scale. Otherwise, the vicious circle of low volume equals high costs, results in a stalemate.

In the effective use of materials, we have much to learn from the aircraft industries. Their methods of design and requirements are so radically different from ours, that we cannot, of course, fully adopt their practices. For example, our equipment is generally so expensive that it has to work right, or perhaps I had better say, before this group, close to right on the first design attempt. The aircraft people deal with smaller parts and they expect to make ten or fifteen design attempts before they arrive at an optimum combination that will just fall apart all over, like the Deacon's "Wonderful One-Hoss Shay", at the end of the allotted life, usually 1000 or 2000 hr.

The increasing use of rather large quantities of power at high frequency in industry is making it necessary to depart from communication practices and build vacuum tubes and associated equipment that are much more rugged and reliable than were needed for their original service in the communication field. To produce rugged tubes, a new alloy commercially called Kovar was developed that had the same expansion properties as the glass used in tubes. Here is a seal of moderate size and rugged enough to withstand severe blows. A material development of this kind is an important step toward making vacuum tubes adequate for industrial purposes, and as acceptance becomes wider, power companies will undoubtedly have to have men on your power sales staff who can promote new loads of this type on your systems.

Metals that will withstand high temperatures without corroding or flowing like molasses under the influence of stress, are going to become of increasing importance to us as time goes on. The other night I looked over my college text books, that do not date back too far, and 730 F was given as the top temperature for turbine blading. Today we are thinking of 1500 F for gas turbine.

R. C. Bergvall, assistant to the vice-president in charge of engineering, Westinghouse Electric & Mfg. Co., was born in Stephenson, Mich., in 1897. He first joined Westinghouse as a member of the Graduate Student Course after graduating from the University of Michigan in 1921. He was transferred to the general engineering department the next year. He became manager of engineering at the Philadelphia office in 1935. In 1938 he went to East Pittsburgh as assistant to the manager of engineering and the following year was appointed to his present position. In 1942, Mr. Bergvall was awarded the Westinghouse Order of Merit for distinguished service. He was cited for his broad knowledge of the design, application and performance characteristics of Westinghouse apparatus; for his understanding of the engineering problems and requirements of the various divisions of the company, and for his ability to coordinate and guide engineering efforts and activities to the best overall interest of the company. The comments presented here are taken from a recent address before a meeting of the AIEE at Roanoke, Va.



WOMAN'S HANDICRAFT

WHATEVER arguments may have been advanced in the past for maintaining that woman's place was in the home, incompetence in the office or factory, cannot be one of them today. Somehow, the light and shadow pattern of this picture makes us think of a piece of Irish lace but it is a long way from a piece of Irish lace to the stators of heavy-duty electric motors such as those shown here. Yet, as far as the women are concerned they seem quite as adept in their work on one as on the other. Julia Hickey (foreground) and Mary Cherpko, shown here, are two of many hundreds of women doing work of this kind today. They are taping the leads of two large Westinghouse motors being built by Westinghouse for the Navy. Almost a fifth of a mile of tape must be wound by hand to insulate the copper conductors of these machines. While a great many more women are employed in factories because of the war, work of this kind is not so new as many may be inclined to think. Long before the war, hundreds of women were employed by electrical manufacturers for work of this type, not always on machines as large as those shown above but of the same general nature

WITH THE EDITORS

◆ **SICK POWER PLANTS** — From one end of this great country of ours clear to the other, field representatives of POWER PLANT ENGINEERING are told by power plant operators of undesirable conditions in their plants. In too many of these plants a starvation policy was adopted during the early '30's which has been continued through better days, when plants could have been modernized, into the present, when only the barest necessities are available for repairs or replacement.

This policy has taken its toll from equipment to the point that in some plants "cannibalism" was quite common practice until increased loads compelled putting equipment which had previously been scheduled for the discard back into service. Then came the mad scramble for new equipment or parts with only a fraction of the demand available.

So today sick power plants are prevalent except among the utilities. The various units of equipment need thorough overhauling. That seems to be the general complaint but there are complications and details some of which are war-born but too many have come as a result of shortsighted policies long practiced by some managers who are not engineers and have little appreciation of the difficulties that can be encountered as a result of such details as the choice of inferior grade of supplies like lubricating oil, packing for various purposes, water treatment chemicals, bearing metals. Nor do they have full appreciation of the exactitude required of workmen in the making of repairs on machines where, in some instances, success or failure depends upon measurements as fine as one thousandth part of an inch.

◆ **COMMON COMPLAINTS**—One engineer complains that motors are his particular headache. He has fifty under his care and these are overloaded and with exacting speed demands his controls function poorly, commutators and slip-rings pit rapidly, bearings heat and wear rapidly, insulation deteriorates—the danger of a breakdown is continuously imminent. The foresight to provide larger or more motors would have prevented the troubles from that source today.

Everywhere you see a steam plant you will find water treatment needs constant watching. When water is properly treated clean boilers prevail but no end of trouble results when the treatment fails by a few parts per million to keep impurities at the optimum.

Valve failures, boiler tube failures due to pitting, combustion difficulties due to variations in fuels, failure of pumps due to packing or destructive vibration, slime in condensers and other cooling equipment, trash in circulating water, worn parts on compressors, pulverizers unsuited to coal now being used, overloaded stokers handling wrong quality coal, furnace linings giving way under excessive loads, and condensate pipe corrosion are but a few of the troubles about which engineers have complained. The pity is that these troubles will grow more numerous and more critical before corrective measures can be universally employed.

◆ **INSPECTION AND REPAIR**—Right now a policy should be enforced in every boiler and power generating plant providing for thorough and periodic inspection of every piece of equipment in the plant. This should be accompanied by a program of repair and replacement that will leave no piece of equipment out of order or deficient in any way that will impair its safety or reduce its efficiency. And that is no small order in these days.

How can it be done? First of all top-notch engineers are required to manage power plants. Men of this caliber would be versed in the fundamentals of practical mathematics, physics, chemistry combined with experience in handling all kinds of tools used in mechanical and building maintenance. To these qualifications should be added the ability to direct the work of tradesmen and the faculty of so presenting his needs to the men in financial charge of his institution that his requirements are provided.

◆ **WHERE MANAGEMENT FAILED**—A severe indictment stands against the management of every power plant that is not placed in the care of such an engineer today. High class engineers by the hundreds were, a few years ago, walking the streets of our cities able and willing to take on the responsibilities of power engineers at salaries extremely modest compared to their worth as money savers. Added to these were hundreds of technical school graduates endeavoring to get started in the interesting field of power generation, ready to enter industry as apprentices where opportunities for advancement were present. But the opportunities were extremely few and other fields claimed these promising young engineers. Likewise in the trades fields—machinists, pipe fitters, welders and the like whose services in many plants could be made continuous with a little thought as to distribution of responsibilities — management let valuable workmen pass out of their reach into factories, and have permitted their power plants to suffer deterioration as well as operating losses due to the mistaken idea common among owners that power plant equipment once installed needs little or no attention other than the shoveling of coal, the squirting of oil, adjustment of controls and generally keeping the place clean.

Prior to the war, many power plants relied to an unwarranted extent upon representatives of manufacturers to service their equipment. Probably no better class of workmen for these jobs can be found than the service men specialized in the products manufactured by their employers. They are, however, specialists and come to a plant only on call which is usually made only in emergencies that demand immediate expert attention. They seldom possess sufficient overall knowledge of a plant to direct the operating personnel, except in regard to their specialized equipment.

Today the services of such men are almost impossible to secure. So power plants that have been depending upon such outside service are finding themselves handicapped.

◆ **MAINTENANCE EQUIPMENT**—Next to engineers skilled in the operation of power equipment under their direct charge and capable of making the common variety of repairs to that equipment, every plant needs the equipment necessary for making those repairs that result from the wear and tear of operation. Among this equipment should be listed pipe fitting tools, a portable welding outfit, bearing repair equipment, soldering outfit, tube scaling tools, tube expanders, valve grinding tools, portable instruments and meters, blacksmith's forge and anvil, and a machine lathe suitable for carrying out the ordinary lathe work of the plant.

This means that some members of the staff must be trained in the use of this equipment probably doubling in the use of some of the related equipment. And in this training program the management can do more for the well being of his plant than in the solution of almost any other management problem.

Government authorities are now coming to the opinion that industry should be thinking of reconversion. The following statement from Donald Nelson is typical: "It is essential to make plans now so that when the proper time does come the transition from a war economy to a peacetime production is as smooth, as rapid and as fair as possible."

◆ **CHANGING SITUATION** — The point in bringing up this opinion in this discussion is to indicate that before long the manpower situation is likely to be changing and if power plant management is wise it will lay its plans now to make positions in power plants attractive to the type of talent needed to keep the entire plant in an efficiently operating condition. This means, of course, salaries or wages comparable to or better than the individuals can secure in other lines of work, working hours and conditions designed for the convenience and comfort of the workmen, training programs designed to improve the skill and ability of the workmen, setting up a policy governing advancements in responsibility.

Until new machinery can readily be secured from manufacturers, users must depend upon replacement parts or plant-made repair parts to keep their equipment running. This condition necessitates workmen sufficiently skilled to design and make these parts in the plant with the tools available. Work of this sort is commonly performed by members of the power plant staff but of recent years the work has become heavier and more exacting due to war conditions, and many of the best workmen have moved into more lucrative fields until today many power plants are sick.

The situation is not hopeless, however, for it is traditional among operating engineers that they will keep the wheels turning even if they have to bind up cracks with baling wire and stop leaks with chewing gum. Nevertheless, nobody can truthfully say that it is not serious and it is to be hoped that owners of power plants will look carefully into the burdens placed upon their operating staff if they find plant services not completely up to par.

More Power at Wyandotte for

Municipal power plant of City of Wyandotte, Mich., serves vital Detroit industries . . . Despite material shortages and delays, new 6000-kw generating unit added in 1943 . . . Details of new turbine-generator and 425-psi, 730-F steam generator, fired by spreader stoker . . . Connections to existing station, extension of auxiliary services, provision for expansion . . . Turbine-generator designed for not over 9.57 lb steam per kilowatthour at rated load . . . How industrial tie-in helped city to pay cash for new equipment

WYANDOTTE, MICH., has recently placed in service the latest addition to its constantly growing municipal power plant. This addition was started before Pearl Harbor and the War Production Board readily recognized that this increment of capacity was vital. In spite of priority assistance, the tremendous demands of war caused delays in equipment fabrication and field construction. The last items of the new equipment were placed in service in early 1943.

The City of Wyandotte, lying on the west bank of the Detroit River, is an important part of the Detroit industrial empire. Instead of automobiles, Wyandotte's industrial resources are largely chemical. Like giant quotation marks, the plants of the Michigan Alkali Co., and the Pennsylvania Salt Co., bracket and emphasize the importance of this pleasant community. The Michigan Alkali Co. for a number of years has operated its power plant in parallel with the municipal plant and such joint operations have reflected savings to both parties. As the loads have grown both plants have been able to minimize the required additional plant capacity. This allowed the city to accumulate sufficient funds to permit cash payments for the new equipment without resorting to any other form of financing.

Operations of this property are conducted for the city by an appointed Municipal Service Commission. The Commission acts as a Board of Directors and employs such managerial, technical and other employees as it deems necessary.

Historical Resume

Nearly fifteen years ago the city erected the first increment of a new power plant. This project included two boilers and a 2000 kw turbine-generator lo-

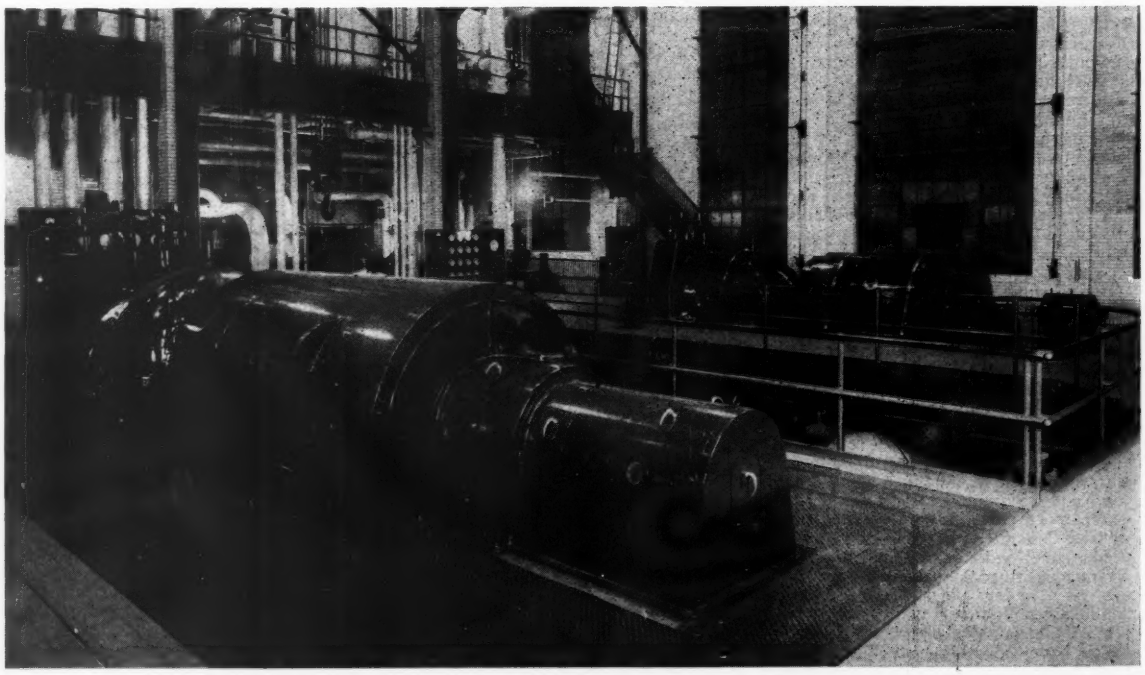


Fig. 1. General view in turbine room, City of Wyandotte municipal power plant. New 6000-kw turbine-generator in foreground; existing 4000-kw unit in background

Wartime Loads

By

A. C. Kirkwood

Burns & McDonnell Engineering Company

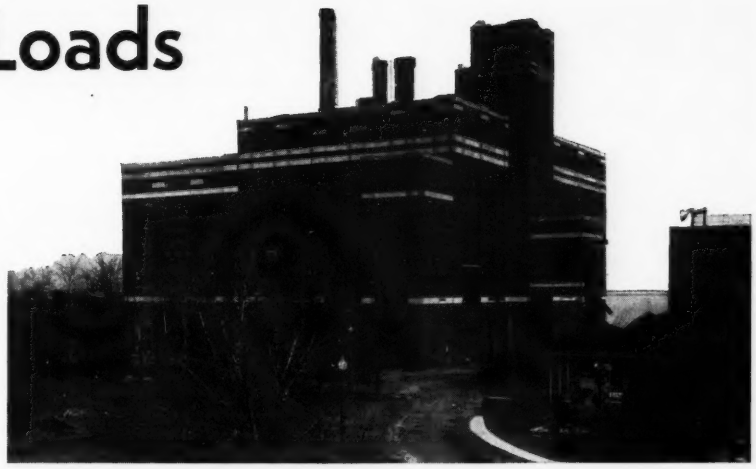


Fig. 2. Exterior view of City of Wyandotte power plant, looking northeast. Detroit River in background. New boiler room addition, with space for two future additional units, lies beyond the tower, which houses skip hoist

cated between the boilers. In 1938 and 1939 the generating capacity was increased in the first section of a new turbine room and space was increased by the addition of a 4000 kw unit. This unit was located in the first section of a new turbine room and space was left for another turbine-generator.

Typical of load conditions during this period is the record of energy generated and purchased as shown in the accompanying table. Years shown are for fiscal periods ending September 30, of the stated year.

Plans were initiated during 1940 for a further increase in plant capacity and in January of 1941, consulting engineers were retained to design the new improvements.

New Equipment

Turbine room improvements consist of a turbine-generator and surface condenser with their auxiliaries, low pressure extraction heater, and essential switchgear, as well as extensions of piping and wiring. New boiler room equipment includes steam generator, extensions to coal and ash handling equipment and additions to piping and wiring.

The previous improvement program included space for the new turbine-generator, consequently structural additions for the turbine room improvements were confined to the turbine-generator foundation and minor additions to the floors. An opposite condition existed in the boiler room, where an addition was required to house the new steam generator. An analysis of all factors indicated the desirability of providing room for more than one unit and the new section of the boiler room will permit installation of two more units.

Turbine-Generator Unit

The turbine unit consists of a 19-stage condensing steam turbine designed for 425 psi, 720 F total temperature at the throttle. Design back pressure is 1.5 in. Hg absolute. Multiple governor valves control admission of the steam and three uncontrolled extraction openings are provided for use in heating boiler feedwater.

The turbine is flexibly coupled to a 3600-rpm, 6000-kw, 7500-kva, 3-phase, 60-cycle, 4800-v, delta-connected generator. A second flexible coupling drives a direct-connected 60-kw, 125-v exciter. The exciter and generator collector rings are totally enclosed and the exciter has its own air cooler and filter.

At rated load, with 80 per cent power factor and operating under specified steam conditions, the unit is guaranteed to require not more than 9.57 lb of steam per kilowatt-hour. Speed control is of particular importance. The governor actuates a primary pilot valve whose function is to control the flow of oil to the primary power cylinder. This latter unit operates through the governor linkage to control the secondary pilot valve and, in turn, the secondary or main power cylinder. Provisions are included in all linkages to substantially eliminate over-travel and hunting.

The turbine oil cooler is mounted conveniently on the grade floor and directly below the high-pressure end of the turbine.

Condenser

Vacuum is maintained by a conventional surface condenser of two-pass design, having an actual surface area of 8680 sq ft. It is designed to produce 28.50 in. Hg vacuum with 10,000 gpm of 75 F water, under a load of 54,000 lb of steam per hour. Two motor-driven circulating water pumps are installed on the grade floor below and adjacent to one end of the condenser. Suction is taken from a concrete tunnel coming from an intake in the Detroit River. Each pump will deliver 5000 gpm at a total head of 30 ft. The rated suction lift is 12 ft. When operating singly, either pump will deliver approximately 6700 gpm. Discharge is to a second tunnel which has a pipe outlet to the river several hundred feet below the intake.

Air removal equipment is located on a platform under the high-pressure end of the turbine and is approximately half way between grade and operating floors. The inter-after condensers are cooled by condensate. Two motor-driven condensate pumps are located in the base of the unit's foundation. Each 2-stage pump is rated at 120 gpm, 150 ft total dynamic head.

Year	Generated Kwhr	Purchased Kwhr	Total Kwhr
1935	11,811,000	3,048,350	14,859,350
1936	12,745,000	3,298,950	16,043,950
1937	13,974,000	2,891,100	16,865,100
1938	14,394,000	3,004,200	17,398,200
1939	15,759,000	3,013,300	18,772,300
1940	18,265,300	2,907,400	21,172,700
1941	22,357,000	1,422,300	23,779,300
1942	26,240,000	582,600	26,822,600
1943	31,807,000	131,900	31,938,900

Fig. 3. Foundation for new 6000-kw turbine-generator, of reinforced concrete, designed to save critical steel and match appearance of steel plate foundation of 4000-kw unit

A shell-and-tube-type low-pressure extraction heater is located on the same platform as the inter-after condenser. Design is based on heating 55,000 lb of condensate per hour from 98 to 170 F using 4010 lb of steam per hr having a saturation temperature of 176 F. Six water passes and one steam pass are employed; the ¾-in. O.D. tubes have a total area of 212 sq ft. Drips are drained to the main condenser.

Steam Generator

The new steam generator is set in line with the two older units. It was originally purchased (April, 1941) to deliver steam at 730 F at maximum (four-hour) load.. This was modified in May to provide controlled temperature at 730 F from 40,000 lb per hr to maximum rating. Difficulties of obtaining high temperature alloys under OPM and WPB regulations necessitated elimination of this added feature and restoration of substantially the original temperature conditions. Considerable difficulty was experienced in obtaining certain materials for the boiler and superheater, resulting in a material delay in completion of this portion of the project.

The unit is rated at 90,000 lb per hr for four hours, 75,000 lb per hr continuously. Superheater outlet pressure is 430 psi and feedwater temperature is 280 F. The air preheater raises the air temperature from 90 F to 289 F and reduces the flue gas temperature from 635 to 448 F at the 75,000-lb-per-hr rate.

The boiler proper is a four-drum, bent-tube unit having 9000 sq ft of heating surface. In addition there are approximately 1200 sq ft of surface in the side and rear water walls. The air preheater is of the tubular type, contains 4800 sq ft. No economizer is included.

Designed for 14,200 Btu (dry) West Virginia bituminous coal, the spreader type stoker has been called upon to burn several other kinds of coal, thanks to the existing fuel situation. The stoker is of the continuous cleaning spreader type employing three feeder sections. The grate, of the modified chain type, moves forward and its speed is a function of boiler load modified by the ash content of the coal.

Ash is dropped from the front end of the grate into a refractory lined cast iron and structural steel ash pit. A cinder catcher or trap is located above the boiler. It is rated to catch 95 per cent of all dust and cinders that will remain on 100 mesh screen, 90 per cent that will pass 100 mesh and remain on 200 mesh, and 65 per cent that will pass 200 mesh and remain on 300 mesh. Cinders and dust are returned to the furnace by secondary air blast. Forced and induced draft fans have dual drives.

Ash is removed from the hopper by an hydraulic system which is an extension of the original equipment serving the first two furnaces. Coal is spouted from an overhead bunker through a weigh scale and a non-segregating chute to the stoker hopper. The overhead bunker is supplied by the original skip hoist and conveyor belt.

Electrical and Mechanical Improvements

The main power system is a three-phase, delta, 4800-v system with all generator and feeder breakers located in a switch-house lying slightly southwest of the plant. Control is from a panel-board located near the original boilers and turbine-generator. Studies indicated that this switchgear was still satisfactory, therefore no changes were made except for installation of the required additional equipment.

The electrical improvements include a section added to the metal-clad board in the control room, a field breaker cubicle on the grade floor under the exciter, additions to the auxiliary power supply for the new motors, and the necessary wiring and conduit.

Piping improvements consisted, in the main part, of extensions of existing headers to accommodate the new equipment. An analysis of existing equipment indicated that feedwater pumping and heating equipment was adequate except for the addition of the previously described low-pressure shell-and-tube heater to operate in conjunction with the new turbine.

Structural Changes

As previously mentioned, structural additions consisted of boiler room extension to accommodate three boilers and construction of foundations and certain floor changes in the existing turbine room. The latter is particularly interesting in that a new concrete foundation was designed to match the appearance of a steel plate and structural shape foundation supporting the 4000-kw unit.

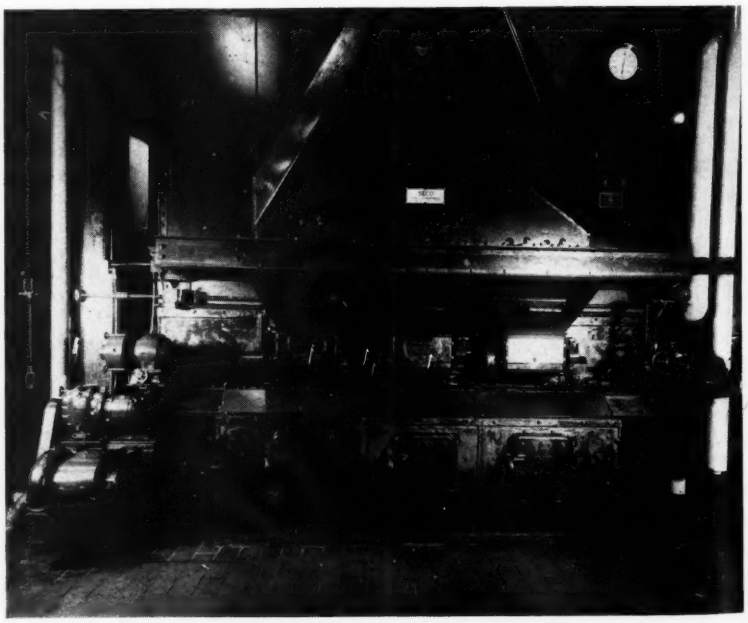


Fig. 4. Front view of new 90,000-lb-per-hr, 425 psi, 730 F steam generator, showing front of continuous-cleaning spreader stoker, stoker drive, non-segregating coal chute

Principal Equipment, City of Wyandotte, Mich., 1943 Extension

Turbine-Generator	DeLaval Steam Turbine Co. with Crocker-Wheeler Electric Mfg. Co.
Surface Condenser	Westinghouse Elec. & Mfg. Co.
Condensate Pumps	DeLaval Steam Turbine Co.
Circulating Water Pumps	DeLaval Steam Turbine Co.
Generator Air Cooler	Griscom-Russell Co.
Exciter Air Cooler	Aerofin Corp.
Exciter Air Filter	American Air Filter Co.
Low Pressure Extraction Heater	Ross Heater & Manufacturing Co.
Steam Generator	Wickes Boiler Co.
Superheater	Foster Wheeler Corp.
Stoker	Detroit Stoker Co.
Cinder Trap	Green Fuel Economizer Co.
Fans	Green Fuel Economizer Co.
Driving Motors and Turbines for Fans	Westinghouse Electric & Mfg. Co.
Magnetic Coupling, I.D. Fan	Electric Machinery Mfg. Co.
Soot Blowers	Diamond Power Specialty Corp.
Boiler Water Columns	The Reliance Gauge Column Co.
Blow-off Valves	ConsolidatedAshcroft-HancockCo.
Feedwater Regulator	Northern Equipment Co.
Ash Removal	Allen-Sherman-Hoff Co.
Coal Scales	Richardson Scale Co.
Coal Chute	Stock Engineering Co.
Combustion Control	Bailey Meter Co.
Substructure	A. J. Dupuis Co.
Structural Steel	Whitehead and Kales Co.
Superstructure	H. B. Culbertson Co.
Piping	General Piping Corp.
Wiring	Commercial Engineering Co.

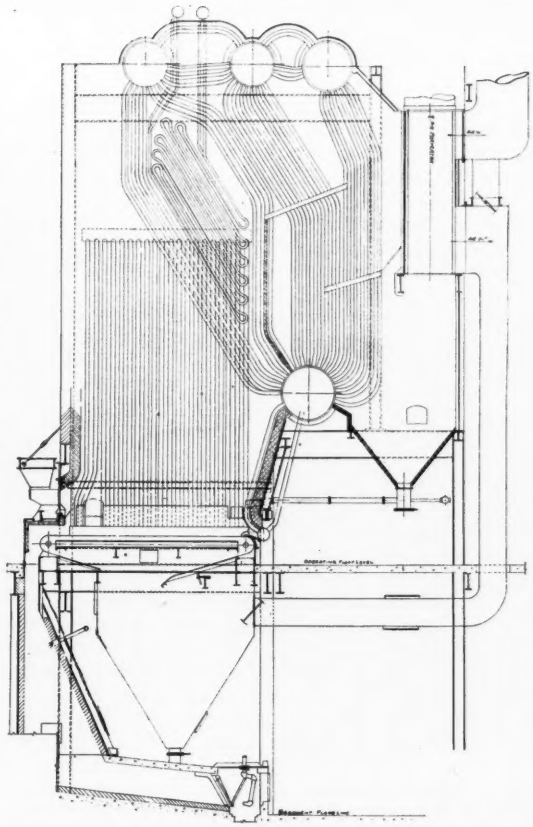


Fig. 5. General cross-section through new steam generator, showing arrangement of boiler heating surfaces, superheating surface, furnace wall surfaces. Forced and induced draft fans (not shown) have dual drive. Coal and ash handling by extension of existing equipment. Boiler rated at 75,000 lb per hr continuous capacity of steam at 425 psi, 730 F. Fired by continuous-cleaning type spreader stoker. Air preheater provides air at 289 F, reduces flue gas temperature to 448 F. Unit under automatic combustion control

It was already obvious in mid-1941 that steel was a critical material and should be conserved. It was also obvious that concrete foundations have certain advantages not possessed by steel foundations, particularly those advantages relating to mass and to noise. The existing steel foundation fortunately had been designed of steel plates reinforced by structural shapes, the whole unit composed of more or less box-like sections. The vertical faces were battered. The new foundation was given the same general shape and, when painted to match the older foundation, it was found to be quite similar to the older foundation.

The boiler-room addition follows the same general design and architectural treatment used in the original building. A structural steel superstructure is combined with masonry walls, concrete floors, and concrete substructure.

The plant is close to the bank of the Detroit River and requires pile foundations. The excavation, piling, and substructure were made the subject of one contract. Excavation was completed to the pile cut-off elevation, or below, and then wood piles were driven to practical refusal. Refusal was calculated upon the basis of a 25-ton load, using established formulae, with piles driven to hard pan or into the stiff clay strata. Pile tops were encased in a concrete mat, upon which were erected the balance of the substructure and the superstructure.

Burns & McDonnell Engineering Co. were consultants and designing engineers for the project. H. E. Allen is General Superintendent for the Public Service Commission; Carl Bufe is Chief Operating Engineer; and Henry A. Girardin is Secretary.

FOR THOSE who are interested in knowing how the capacity of the steel industry is figured, as given in Front Lines, Dec. 1943, the following information has been supplied by American Iron and Steel Institute: Rated capacity of the steel industry is the sum total of the maximum output in recent years of each furnace in the industy, less a deduction averaging about 11 per cent to allow for time lost in shutdowns for repairs. By speeding up the repairs and reducing length of shutdowns, steel companies can produce more than their rated capacity indicates.

Heat Absorption and Performance Factors of Twin Branch 2500-psi Boiler*

F. G. ELY, *Analytical Engineer*
The Babcock & Wilcox Co.
and
L. B. SCHUELER, *Engineering Department*
American Gas & Electric Service Corp.

Absorption of heat in furnace averages 46,000 to 48,000 Btu per sq ft per hr . . . Study of two tube failures . . . Effect of slag removal on furnace wall tube temperature . . . Effect of applying stud plates and chrome ore . . . Slag characteristics . . . General survey of thermal performance shows how various sections absorbed heat

INITIAL OPERATION of the Twin Branch 2500-psi boiler gave immediate indication that the heat absorbed by steam, particularly in the reheater, was too great. The full temperature of superheat and reheat were attained at approximately 70 per cent load, using all the gas-bypass and attemperator control capacity available. This condition initiated a comprehensive field investigation.

In the original arrangement, the reheater surface included exposure of the side-wall area of the first and second open passes, as well as the roof and rear wall of the second open pass, and the sloping floor of the cavity under the convection pass. The final-stage superheater likewise had a greater area of exposed surface by extended arrangement of the platen tubes instead of the grouping as now disposed.

Temporary alterations were made immediately, consisting of applying a gunnited refractory coating to the side-wall reheater tubes, covering one-half of the surface of the reheater hopper slope, closing alternate gas lanes in the primary-reheater convection bank with refractory concrete, and increasing the capacity of the attemperator spray nozzles. These changes[1] permitted operation up to 80 per cent of full capacity without exceeding safe tube and steam temperature; some advantage being gained by running with lowered excess air and by over-attemperation in the superheat cycle to produce steam temperatures lower than design level in order to lower the temperature of steam returned to the reheat cycle, since the reheater proved to be the most critical portion of the heating surface.

The unit was operated for several months in this condition for the purpose of gaining experience, pending delivery of materials for the projected rearrangement of surfaces.

Test Investigations

Tests were run to obtain data on heat-absorption rate and distribution of heat throughout the unit, and particularly in the furnace and open passes where high gas temperatures prevailed and where important increments of steam-heating surface were present. The circumstance that all the steam-generating surface of the boiler was in the primary furnace and open passes provided a unique comparative means of measuring and evaluating heat-absorption rates by means of two independent methods.

By utilizing the temperature differential between tube-surface temperature and saturation temperature, and assuming negligible inner surface resistance to heat flow (which condition has been convincingly demonstrated for tubes with positive circulation), it has been possible to calculate equivalent values of local heat-absorption rates which reveal an interesting pattern of the distribution of heat in the furnace. The average of 46,500 Btu per sq ft per hr compares rather closely with the value of 46,000 for the overall furnace, as determined by gas-temperature test methods, and the value of 48,000 shown by the slagged thermal probe.

Slag and Heat Absorption

An example of the influence of

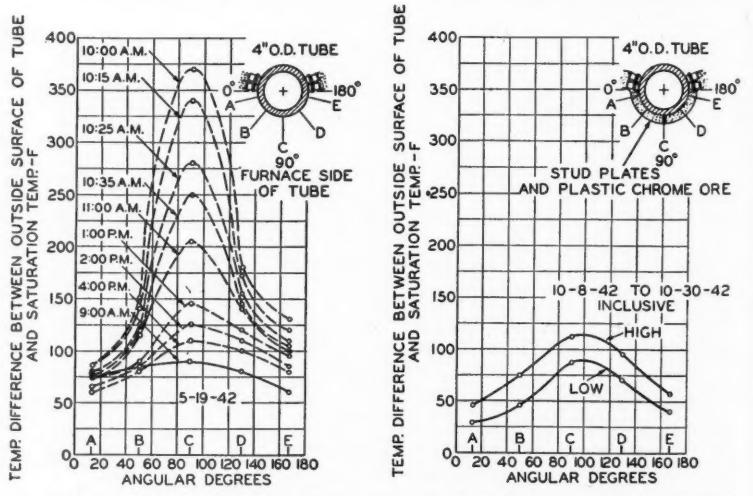


Fig. 1. Left—Chart showing distribution of temperature of furnace wall tubes, illustrating effect of slag removal from bare tube surface. Right—Temperature distribution following application of stud plates and chrome ore

*Abstract of paper Distribution of Heat Absorption and Factors Affecting Performance of Twin Branch 2500-psi Boiler, presented before Annual Meeting ASME, Nov. 29-Dec. 3, 1943. This is one of three related papers on Twin Branch. The first, giving the operating history, was abstracted in POWER PLANT ENGINEERING, January 1944, pp. 78-84; the second on Natural Circulation Tests appeared in the February issue, pp. 124-126.

[1]See POWER PLANT ENGINEERING, January, 1944, page 79.

slag on local heat-absorption rates and metal temperature of bare furnace-wall tubes is shown in Fig. 1, Left. This plot represents a series of readings taken from thermocouples installed at five points, around the circumference of a tube in the left side wall of the primary furnace, at elevation 15 ft above the furnace floor. This is near the zone of maximum heat intensity. Shortly after 9 a. m. a sudden increase in tube temperature was observed, and inspection showed that the fused slag coating on the tubes in this area had peeled or crept away, leaving tube surfaces exposed directly to furnace radiation. The sudden increase of 280 deg is equivalent to a gain in heat-absorption rate from approximately 40,000 Btu per sq ft per hr at 9 a. m. to 160,000 Btu per sq ft per hr at the 10 a. m. reading for the local area affected by loss of slag protection. In the course of the next 6 hr, the tube returned to lower temperatures as the slag coating was restored by the normal process of accumulation in the furnace.

Analysis of Tube Failures

One practical significance of this occurrence becomes evident in considering the causes which led to the failure of two tubes in the upper portion of the first division wall. These failures were located on the furnace face of the tubes and occurred during the period when alternate tubes were omitted from this portion of the wall, allowing furnace gases to short-circuit into the upper part of the first open pass.

It was established that slag peeling in certain portions of the primary furnace, particularly where both radiation and convection heat exchange were imposed on the tube, could result in absorption rates as high as 200,000 Btu per sq ft per hr. A gradual increase in absorption rates to such a level would probably be less harmful than a sudden increase, since the full temperature stress would not be realized due to creep permitting considerable "relaxation." However, with sudden peeling of slag, and exposure, it is probable that the full elastic properties of the material were retained long enough to develop the full elastic stresses so that the yield stress was exceeded.

Although analysis indicates that the ultimate stress was probably never reached, as a consequence of thermal stress, the fact that failures did occur can probably be explained by the results of careful laboratory examination of the failed tubes. These showed that the areas surrounding the failures were bulged and the microstructure indicated that the outer portion had been subjected to temperatures as high as 1600 F and the inner wall had been appreciably higher than saturation temperature. Examination also showed oxide deposit inside the tube in a small area around the ruptured zone, and measurements showed that appreciable thinning of the original wall was produced at the immediate line of rupture.

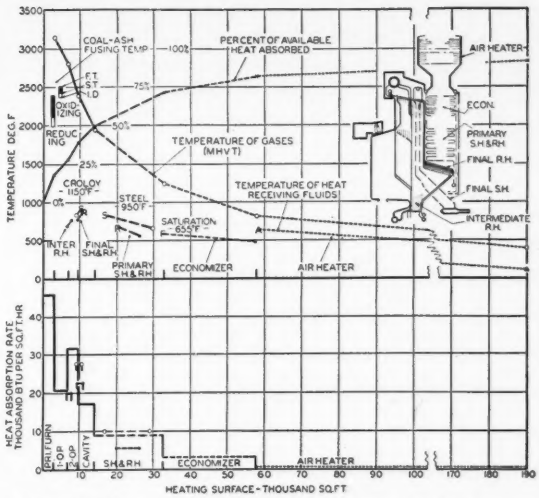


Fig. 2. General survey of thermal performance conditions in 2500-psi boiler at 570,000 lb per hr output

The conditions surrounding the failures, that of internal-corrosion attack, blistering, and apparent rupture due to hoop stress in excess of the ultimate strength, could not be logically ascribed to inadequate circulation as is sometimes the case for such occurrences, since later tests[2] established the adequacy of circulation in these circuits. A hydrogen recorder, for continuous sampling and analysis of feedwater and saturated steam, gave positive evidence of the corrosion phase involved in these tube failures.

Probable Rupture Causes

A probable logical sequence of conditions leading to ultimate rupture of the tubes has been established as follows:

1. Peeling off of slag exposing the bare tube to concentrated radiant and convection heat transfer, resulting in sudden thermal stress and normal pressure stress, combining to exceed the yield point at the inner fiber of the tube.

2. Slight permanent "stretch" of inner fibers, producing a small blister in which formation of a steam film leads to corrosion attack which produces an oxide layer in the affected area.

3. Recurrent or continued exposure of this zone, producing overheating and further blistering of the area with ultimate rupture due primarily to pressure stress in excess of the ultimate strength at the temperature attained. There are three likely alternatives for overcoming the difficulty described. These are as follows:

1. The use of smaller diameter tubes with corresponding decrease in thickness in accordance with Boiler Code rules. This would produce lower thermal stress at a given heat-absorption rate, but at the expense of circulation efficiency.

2. The use of thinner wall tubes of the same diameter provided sanction of Boiler Code authorities could be obtained.

3. Application of a protective covering to the existing tubes which would prevent direct exposure of bare tubing in case of slag peeling, but would withstand action of temperature and slag conditions prevailing.

Remedy Applied

The first two of the foregoing alternatives were impractical, since the Twin Branch unit was already built and operating and could not be spared for any such major alterations if they had been considered preferable. Alternative 3 was the only one seriously considered as satisfactory and practical. The application of stud plates welded to the tube face at intervals, with refractory material packed between plates, had given satisfactory performance on numerous other installations under severe operating conditions. Furthermore, experiments with thermocouples on adjacent bare and covered tubes in the primary furnace of another unit had demonstrated the effectiveness of the stud-plate construction as a

(*Continued on page* 136)

[2]See POWER PLANT ENGINEERING, February, 1944, page 124.

Modernizing Circuit Breakers with De-ion Grids

The addition of De-ion grids greatly increases the interrupting capacity of old breakers. In some cases, merely the installation of the grids is necessary; in other cases the useful life of the breaker is extended by water proofing and by the installation of accelerating springs. In some instances the critical metal salvaged from the old breaker contacts is greater than that needed for modernization

By A. W. HILL

Circuit Breaker Engineer, Westinghouse Elec. & Mfg. Co.

EVER SINCE De-ion grids were introduced in 1929, a continued interest has been shown in the benefits to be derived from their application to old breakers. Increase of interrupting capacity, reduction in the amount of maintenance required, faster interrupting time, general improvements, etc., have all been factors influencing modernization.

Early field tests were all made on revamped breakers and served to quiet any fears that the old units might not withstand the more severe duty. For instance, the first 66 kv tests were made at a substation of the Duquesne Light Co. on a breaker which had given ten years of service prior to the test. At this time, stationary contacts, moving contacts, lift rods, and guides were removed. Then De-ion grids were installed without any other change. The ability of the breaker to handle maximum duty at this station was amply demonstrated; 50 short circuits were cleared in a period of 2¼ hr and more than half involved currents above 3000 amp.

Similar demonstrations were made later on other revamped breakers which included: 1. A type G-2, 110 kv breaker on the lines of the Alabama Power Co. 2. A type G-222, 73 kv breaker of the Cincinnati Gas and Electric Co. 3. A G-222-A, 73 kv breaker of the Scranton Electric Co. All of these breakers had been in regular service for periods up to 10 yr and tests were made in their normal yard position; only stationary and moving contacts were changed. During the tests, the new form of contact suffered no damage and was permitted to remain in service. Immediately following the tests, other breakers in the same stations were

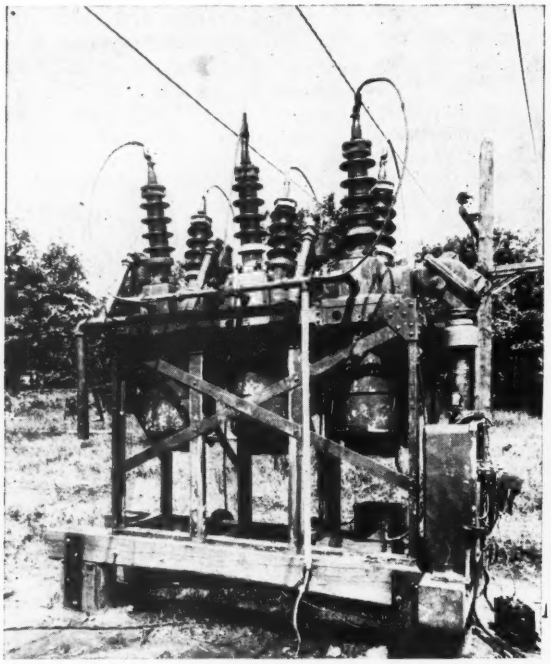


Fig. 1. Type O-221 37 kv breaker set up test with De-ion grids at a 26 kv substation of the Public Service Electric & Gas Co. of New Jersey

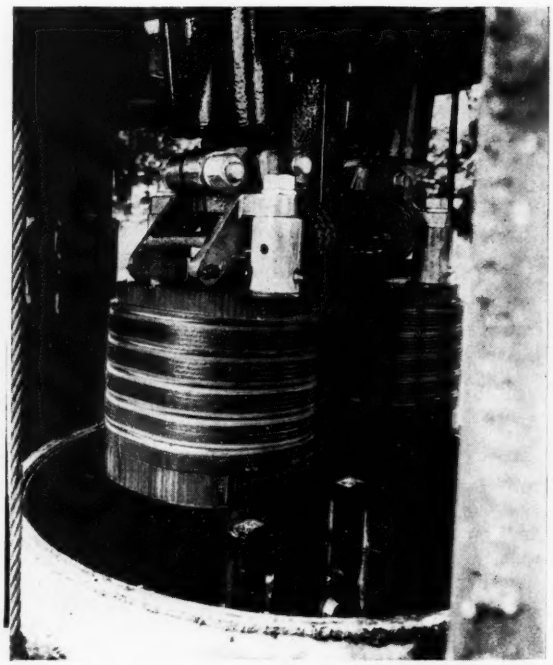


Fig. 2. De-ion grid contacts in Type O-221 breaker after 26 kv short circuit tests on the lines of the Public Service Electric & Gas Co. of New Jersey

equipped with De-ion grids; in all cases they have provided uninterrupted service ever since.

At the time of these earlier tests, the principal aim was to improve interrupting ability and reduce breaker maintenance. However, it was realized that in so doing, the useful life of the breaker was being extended quite appreciably; thus steps were frequently taken to improve weatherproofing details while the breaker was temporarily out of service. This was true of the Alabama Power Co. breaker which had been built to 1920 standards. Where metallic gaskets had been relied upon for sealing the conduit pipe at its joint with the tank top, instructions were given for threading the top casting, and new pipe details were furnished which included a compound-filled seal for the leads from the brushing type current transformer secondaries. At the same time baffles were added to the interpole pull rods to isolate each pole from the others and from the operating mechanism; thus oil and gas could not communicate through either conduit or pull rod piping. An improved vent was added to prevent rain and snow from entering the tank. The new vent included a vertical length of pipe which was laid over the top edge of the tank, making it splash-proof.

As De-ion experience was extended, it became evident that further minor changes were justified in order to increase lift rod speed as the breaker opened; therefore, accelerating springs were added, up to the limit of the closing mechanism. On some breakers a "tail spring" at the pole most distant from the mechanism is installed on an extension to the horizontal interpole pull rod. Thus, the pull rods are kept in tension at all times. Especially with larger breakers this eliminates slack and consequent loss of time between breaker unlatching and actual contact movement. On smaller breakers, where loads are less and pole-center-spacing is smaller, this does not present such a problem. Frequently it has been simpler to add a spring and collar on the vertical pull rod, between operating mechanism and bell crank. Except that the spring does not exert tension over the entire pull rod system, the effect is the same.

Along with higher opening speeds resulting from use of lighter moving contacts and greater accelerating forces, it was found desirable to add oil dash pots to absorb the energy of moving parts. Without this protection many breaker contacts bounce to a considerable extent. It was possible that the power arc might restrike as the moving contact jumped back toward the gas bubble of the earlier interruption. Logically a dash pot was introduced under the lever system and was mounted below normal oil level of each tank. Such a piston and cylinder, provided with graduated holes for escape of oil, stops the moving parts with substantially no rebound. Many of these dash pots have a ball-valve built into the cylinder; this with a retrieving spring, allows for quick re-setting of the piston.

A completely new operating mechanism frequently adds enough to performance to justify cost of installation; this is particularly true where acceleration must be added in such an amount as to overload the existing mechanism. It is necessary also to be sure that other levers of the pole units will stand up under the added stresses of heavier pull and faster operation. In some cases it has been necessary to remove the older cast levers and install new levers fabricated from high grade steel for lightness, strength and stiffness. Only in this way could the desired speed be obtained.

Many old breaker mechanisms are mechanically non-trip-free; thus, they are not well suited to operation with fast protective relays. If such a breaker is closed against a fault and the protective relay tells it to trip, opening movement cannot start until the flux in the closing magnet dies out; this may require 10 or 15 cycles for completion depending on closing coil cut-off, control voltage, type of

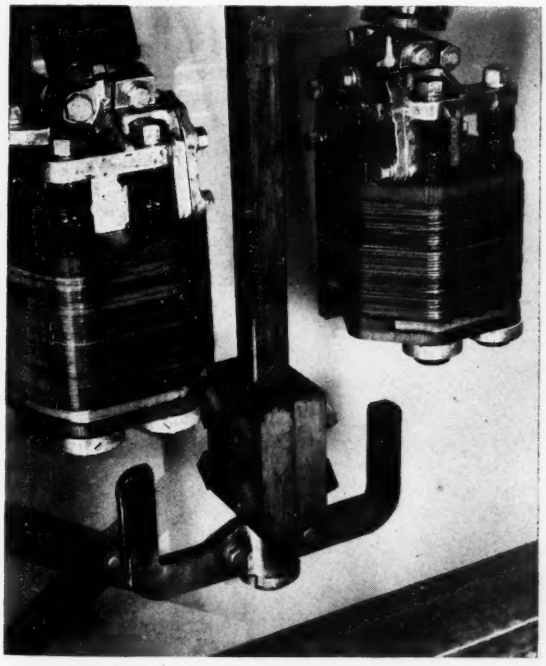


Fig. 3. Moving and stationary De-ion grid contacts after Westinghouse High Power Laboratory tests—Detroit Edison Co. breaker subjected to short circuits ranging up to 1,000,000 kva

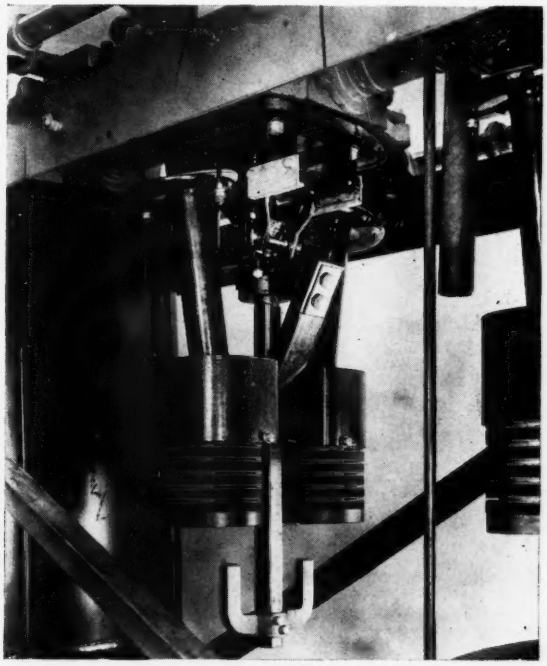


Fig. 4. Typical arrangement of De-ion grid contacts such as are used in revamping old breakers

magnetic core circuit, etc. This was acceptable in former days when relay settings were measured in seconds or major fractions thereof. If opening of the breaker is independent of closing means, as with the newer mechanically trip-free solenoids, it is possible to get immediate opening movement comparable in speed with modern high speed relay timing. Adding new solenoids usually involves a small amount of burning and welding in the field, since it is necessary to provide different angle-iron supporting members. As far as possible, all partial assemblies are welded at the factory so as to reduce the field work to a minimum.

De-ion grids occasionally require more space than is available in original tanks. If more height is needed, sometimes a steel ring 3 or 4 in. high can be inserted at the top of the old tank; this entails use of longer tank bolts and relocation of the oil gage so as to hold normal oil level around bushings and dash pots. For inspection and cleaning of contacts the original tank can be detached from the ring; thus it is possible to drop and remove the tank with practically the same clearance as with the older contacts. Obviously, if lateral clearance is inadequate, the only solution is to furnish new "bottleneck" tanks.

While many of the earlier revamping programs were based on demonstration of the performance of the breaker in a field test, this generally cannot be done because in most cases it is not feasible to stage short circuit tests up to the desired rating of the breaker. For several years such demonstrations have been possible in the Westinghouse High Power Laboratory at East Pittsburgh. Many purchasers have checked the operation of their revamped breakers by sending one of them to the factory where many short circuits can be applied. Such tests cover a variety of conditions involving current, voltage, lift rod speed, operating temperature, choice of contact design, tank clearance, etc. Thus in a few hours, it is possible to demonstrate what would normally take many years of operating experience. Moreover, the tests are made under conditions which prevent unnecessary abuse of the apparatus in case of failure; at the same time, complete breaker-performance records are obtained.

As a result of very satisfactory laboratory and field experience, De-ion grids were installed on more than 1500 large outdoor-breakers during the first ten years they were available—almost equalling the number of new breakers sold for similar service. While they covered the entire range of voltage and interrupting capacity, nearly one-fourth of them were Type O-221 breakers used in service up to 33 kv. Eighty or more similar units have been revamped by the Public Service Electric and Gas Co. of New Jersey. Undoubtedly, their interest was stimulated by a test made in 1931 on their 26 kv system. Modernization of older breakers is particularly important now since materials involved are largely those not high on the critical list; at the same time, quantities are far less than required for a complete new unit. In some cases, critical metal salvaged from the old breaker contacts is greater than that required for the De-ion grid modernization.

Ready-to-Set Glass Vee Jewels

PREVIOUSLY OFFERED as run-of-mill quality, General Electric glass vee jewels are now ready to set. Before jewels are shipped, they are examined under a binocular microscope, which has a magnification of 40 diameters, for incipient flaws in the glass, the depth of the vee and its concentricity. Simultaneously the bearing is explored for pits or roughness with a fine steel needle. All jewels now furnished have passed this rigid inspection and are ready to be set in jewel screws.

A Thimble Full of Jewels

Glass vee jewels have been manufactured in tremendous quantities since the beginning of the war to replace imported sapphire jewels which have become practically unobtainable. G.E. has supplied the majority of these jewels to the war effort. They are used in small panel instruments with a moving system which weighs one gram or less. The jewels have the same coefficient of friction as the sapphire and in combination with instrument steel pivots, under vibration, they often produce less friction increase than does the sapphire.

Vast improvement has been made in the glass as compared with that previously used. These jewels will resist shocks in excess of those required to damage instrument steel pivots. This is because the glass jewels are specially designed for this application.

Two sizes of glass vee jewels are now available; diameters of 0.051 and 0.076 in.

Potential Transformers Shrink in Size

POTENTIAL TRANSFORMERS, too, keep in step with the general trend to smaller size and lighter weights for things electrical. A new family of potential transformers, 25 to 138 kv, are but midgets compared to their predecessors, according to Westinghouse enginers. A typical example is the 69-kv unit which is only two-thirds as tall as former models. It requires less than one-third the ground space and occupies one-fifth the volume. Furthermore, it uses one-eighth as much oil and weighs two-fifths as much as previous potential transformers.

These reductions are made possible chiefly by use of Hipersil steel and a new type of bushing. Close coordination of insulation structure, coupled with design features which permit liberal substitution of non-metallic materials for structural and supporting members, are no less important factors.

Comparison of old and new potential transformers. Great decrease in size of the new models is due chiefly to Hipersil steel and a new type of bushing

FILES—THEY STILL USE 'EM

In these days of power machinery we almost forget about some of the basic operations that grandpa had to do by hand. Though unromantic, proper file manipulation is an art which plays its part in every war plant today. Made in a wide range of shapes and sizes, this tool will always be with us. It not only serves to glamorize milady's fingernails but also puts the finishing touch on many machine parts.

Fig. 1 (Above)—Square Swiss pattern file used by a Westinghouse woman worker to finish a square hole of a die used to stamp parts from a circuit breaker assembly

Fig. 2 (Left)—Here a half round file serves the purpose of a skilled workman for rough interior work

Fig. 3—Abrasive tool guide makes precision filing possible. Here Harry Morrison, Westinghouse workman, files gages to an accuracy of one ten-thousandth of an inch

Fig. 4—Flat file smoothes a part for a blower to ventilate a Westinghouse generator destined for a war production plant

Coal-Handling Equipment
Saves Men, Time, Transport for War

Detailed descriptions of several wartime coal-handling installations . . . Eliminating coal-handling labor . . . Coal and ash silos . . . A storage pile conveyor for $100 . . . Concrete coal storage building for pumping plant . . . Arrangement of various conveyor systems

By Francis A. Westbrook

THE MANPOWER shortage due to the war has made the use of coal-handling machinery particularly advantageous at this time, especially now that the greatly increased production schedules make it necessary to burn a great deal more coal in so many war production plants. There are plenty of instances where mechanical coal-handling equipment has been the means of saving so much in time, labor and money that new installations

Fig. 1. Grating over track hopper of coal conveying system for ice plant

have paid for themselves in a year or less. In addition to such considerations, there is the further advantage that much-needed freight cars are held up at company sidings for a much shorter time before going out again for new loads of war materials; and, of course, the user of the coal is saved demurrage charges to a corresponding degree. How all this has worked out in actual practice can readily be demonstrated by considering a few specific installations.

System for an Ice Plant

Typical wartime coal-handling installation is one at an Indiana ice-making plant. Up to less than a year ago, the 22 tons of 1¼-in. screenings used daily was shovelled by hand from flat-bottomed freight cars and thrown through an opening in the wall of the boiler house to the floor. After that it was necessary to stoke the furnaces by hand. There are three 150-hp boilers of which two are usually in operation, the third being held for stand-by. That this consumed a lot of manpower, and was a dirty job besides, need not be stressed. Installation of mechanical handling equipment eliminated the dirt and most of the manpower.

Coal is now delivered in gondola type cars, which are spotted over the steel grating covering a track hopper, shown in Fig. 1, whence a conveyor system carries it direct to the boilers. One man can open the gates in the bottom of the railroad car and press the push button that starts the conveyor—and that is all there is to this plant's coal-handling problem.

The track hopper keeps out pieces of coal too large for the conveyor to handle, also foreign material large enough to cause trouble. The mechanical handling equipment is very compact and consists of a Bulk-Flo horizontal and vertical elevator-conveyor (one machine) and a system of chutes to the boilers. The horizontal section extends under track hopper on the outside of the building to the vertical run located just inside the boiler house wall, as shown in the left background of Fig. 2, where it discharges into a system of four chutes. Three of these chutes lead to the three boilers and the fourth to a reserve storage pile on the floor. Each chute is provided with a hand-chain-operated, rack-and-pinion-type slide gate whereby the flow of coal to any of the four points may be controlled.

As the conveyor operates very

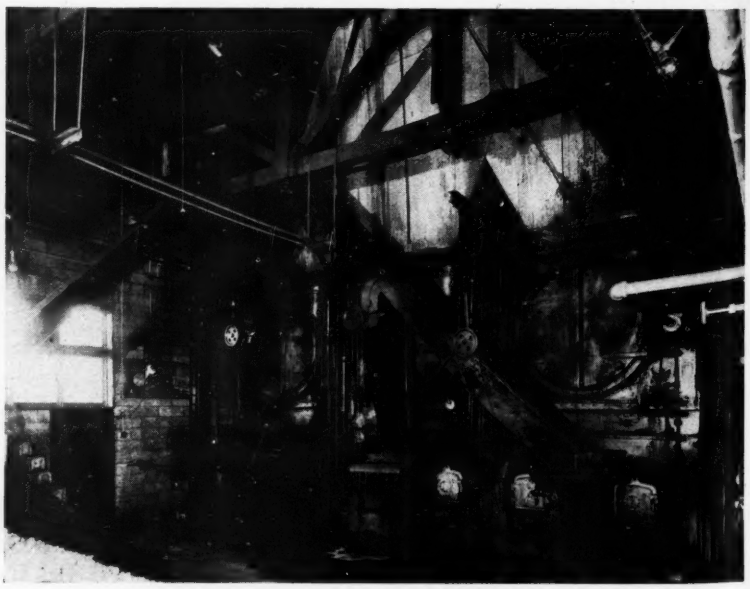


Fig. 2. Coal unloaded at track hopper of Fig. 1 is conveyed by elevator-conveyor to chutes feeding stoker hoppers and reserve storage pile in ice plant boiler room

Photos courtesy Link-Belt Co.

slowly, a 2 hp motorized helical gear speed reducer located at the head of the elevator provides sufficient power. The drive from the reducer consists of a roller chain with the driven wheel equipped with a radial shear pin hub for protection against damage in case the conveying system becomes jammed or overloaded.

Use of Silos

Figure 3 shows the outside of a new 597 hp boiler house addition, at a large mid-western chemical plant, having silos for coal storage and ash disposal. The coal silo at the left is filled by means of a conveyor-elevator system coming from a track hopper similar in principle to that of Figs. 1 and 2.

Ash is conveyed to the top of the silo at the right by a skip hoist, the cover of the silo being opened automatically by the ascending skip. An undercut gate has been installed in the bottom of this silo for loading ash into trucks.

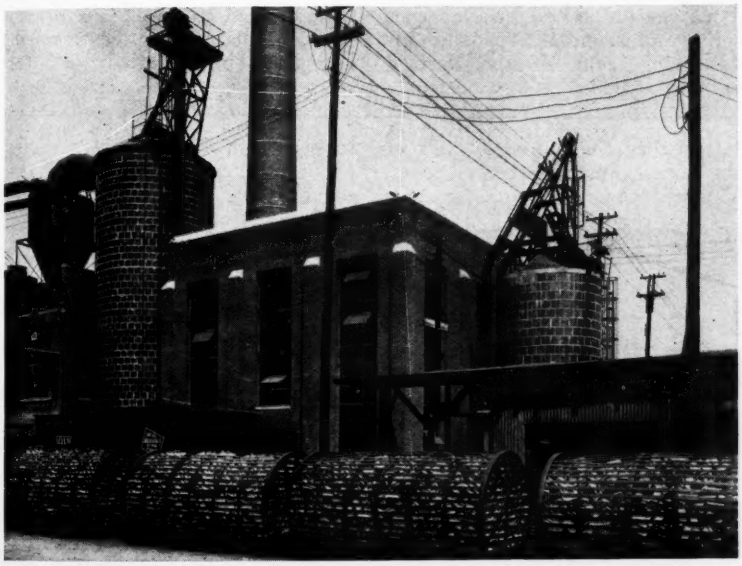


Fig. 3. Chemical plant stores coal in silo at left, ash in silo at right. Ash loaded to silo by skip hoist, which automatically opens cover

This type of coal-handling equipment is as applicable to comparatively small plants, so far as savings are concerned, as to large ones. Sometimes a high degree of ingenuity must be exercised in getting the most from such an installation.

Expanding to Make Storage Pile

An excellent example is in an old established business with a factory, boiler plant and railroad siding located on the bank of a river in the Middle West. Steam is provided by two 400 hp boilers under which about 50 tons, or a carload, of 1¼-in. screenings are burned every four days. The coal was formerly handled manually.

A conveyor-elevator system was then installed to carry the coal from a track hopper to an overhead horizontal screw conveyor in the boiler house, distributing the coal on the floor in front of the boilers. In this case, the elevator takes the coal directly from the track hopper to the overhead horizontal conveyor.

This installation was made just before Pearl Harbor and seemed adequate for the increased needs of the Defense Program of that time. However, when war was declared, it became desirable to provide an emergency coal storage pile. This would have been possible by extending the screw conveyor through the wall of the boiler house and making a storage pile outside. Such a procedure, of course, had the disadvantage of using up critical materials and also of spending money for equipment which would probably not be needed after the war. This use of more conveyor, and supports, has been avoided by the expenditure of only about $100.

What was done was to connect a 6-in. galvanized leader pipe, as shown in Fig. 4, at the last gate in the existing horizontal screw conveyor. A fire hose was then connected to the pipe back of where the coal is discharged into it. Water pumped from the river forces the coal through the leader pipe which passes through the wall of the boiler house and out to the storage space. A storage pile covering considerable space is easily made by changing the direction and length of leader pipe.

Concrete Storage Building

Storage of large quantities of coal, under restricted conditions, has been provided for at a municipal pumping station. In this case there are five 500 hp stoker-fired boilers. A coal storage building 246 ft long, 26 ft wide and about 60 ft high, divided into ten bins 23 ft square with hopper bottoms, has been built as shown in Fig. 5. Physical conditions made this type of structure a necessity.

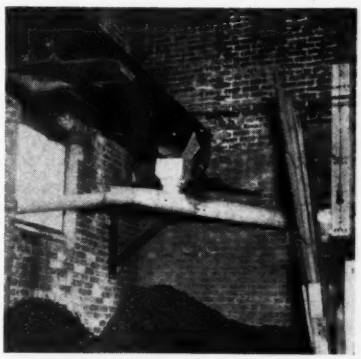


Fig. 4. View showing how auxiliary conveyor, using water jet to carry coal, transports it from last gate of inside screw conveyor to outside storage pile

The requirements of the mechanical coal - handling system were: to deliver coal from the track hopper to any one of the bins and from them (or direct from car) to the bunker above the boilers; to move coal from one bin to another; and to provide for crushing run-of-mine coal (in case the regular coal should become unavailable) and of frozen lumps.

These conditions were met by installing a 30-in. wide overlapping, steel-apron conveyor feeder from the track hopper to the crusher or direct to a lower run of Peck carrier. The feeder operates at 10 fpm and is driven by a 5 hp high-torque, totally-enclosed, ball-bearing, squirrel-cage motor. When coal is being handled that does not need crushing, the crusher rolls are opened so that the coal passes through the latter to the Peck carrier. This carrier is some 900 ft long, with a rectangular path having a lift of 62 ft to the tops of the ten storage bins, a run of 388 ft horizontally

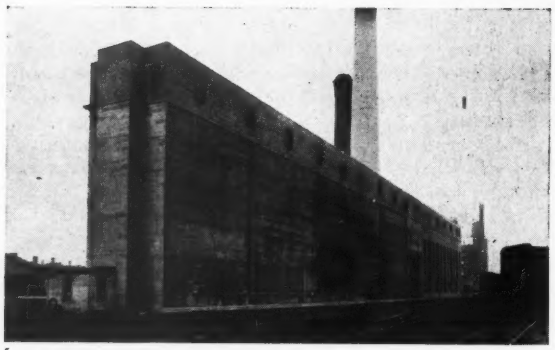


Fig. 5. Long, narrow, concrete storage building stores coal for municipal pumping plant. Conveyor in this building shown in Fig. 6

Fig. 6. In storage building shown in Fig. 5, this conveyor delivers from track hopper to any of several storage bins, reclaims and delivers to bunkers in adjacent boiler house

along the top of these bins to the boiler house bunker and a return bottom run under the bins of equal length, with, of course, a descending run of 62 ft.

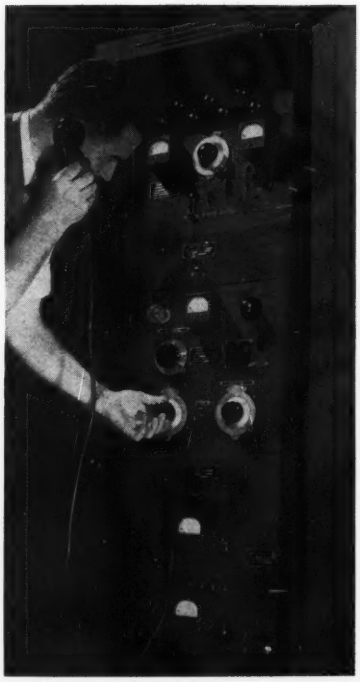
Thus coal is taken by the apron feeder from the track hopper, delivered to the Peck carrier through the crusher, which may be in operation or have its rolls set apart, up to the top of the bins to drop coal into any one, down to the bottom run where coal may be taken from the hopper bottom of any bin and carried up and around to any other bin. The carrier naturally extends into the boiler house to deliver coal to a parabolic, gunite-lined suspension bunker having spouts to the stoker hoppers of each of the five boilers. Adjustable dumpers along the top run of Peck carrier, set by an attendant, provide for delivering coal to the desired point.

The carrier travels between 40 and 50 fpm and is capable of handling 50 to 60 tons per hr. Its operation is quiet and without vibration and a 25 hp motor is sufficient for the drive. Figure 6 shows a view of the upper horizontal run with the pivoted buckets being tilted by the dumper to discharge coal into one of the storage bins below. The system has given very satisfactory results.

New Carrier Current System Does Ten Jobs at Once

CARRIER CURRENT can be applied to transmission-line conductors for the purpose of carrying electric power, voice, relaying, telemetering, or control signals. The scheme usually employed generates a carrier or radio-frequency signal and superimposes it on the transmission lines. By starting and stopping this carrier wave on a code basis, according to Westinghouse engineers, various relaying, supervisory, or metering signals can be transmitted one at a time. The wave can be modulated by audio waves for voice communication. Normally, when the carrier wave is interrupted to carry one kind of signal, it cannot be used to perform other chores.

New Westinghouse equipment now makes this possible. A carrier frequency is generated as before, but it is transmitted continuously. It serves as a continuous vehicle for as many as ten independent tones or audio waves, each of which can be used as a channel for a different function. Thus, it is possible to have ten different pieces of intelligence sent simultaneously with other functions. When it is desired to accommodate a frequency band wide enough for satisfactory communication, six of the tones must be dropped out. This still leaves four tones for other functions that are entirely independent of each other and of the conversation.



Operator uses the phone channel on new Westinghouse carrier current system. Note various panel units that can be arranged to suit a particular installation. Ten independent audio waves are available for as many different functions

In addition to these great application advantages, the new carrier equipment is also arranged for maximum mechanical flexibility. Transmitter and receiver panels, individual tone panels and all auxiliary panels are standard 19-in. relay rack type. This permits convenient arrangement in many desired combinations since several sizes of cabinets are available.

Periodicals Wanted for Foreign Libraries

A committee of the American Library Association is collecting scientific and technical journals for eventual shipment to foreign libraries and institutions unable to get them now because of the war. The Committee is eager to acquire POWER PLANT ENGINEERING because the publisher's back copy supply is exhausted for many issues published during recent years. Only through your gifts can copies be obtained. The Committee will provide storage space if necessary. If you wish to help by donating your periodicals, please write to Dorothy J. Comins, Executive Assistant, Committee on Aid to Libraries in War Areas, Library of Congress Annex, Study 251, Washington 25, D. C.

The Gas Turbine— Part II*

An Engineering Possibility Today

By

SANFORD A. MOSS, Ph.D.

Consulting Engineer, Supercharger Engineering Division, General Electric Co.

The gas turbine as a prime mover has not yet been applied extensively, except in isolated cases such as 4000-kw power plant at Neuchatel, Swiss Federal Railways locomotive . . . Partial gas turbine cycles, combining turbine with internal combustion engine and with industrial processes, are in use. Development of constant-pressure aviation turbosupercharger, begun as World War I project in 1917, brought to highest state by author's company. Alternation of developments between gas turbine and turbosupercharger has accelerated the former's progress towards being a prime mover

THE General Electric gas-turbine work, previously mentioned as beginning in June, 1903, continued until about 1907. At first the power for compression consumed all the turbine power. But a simple approximate computation can be made which will show the other side of the picture. Suppose the initial pressure for the compressor and the exhaust pressure of the turbine is 14.7 psia and suppose the final pressure of the compressor and the nozzle inlet pressure of the turbine is 49 psig or 63.7 psia. With such equality of initial and final pressures for turbine and compressor, the ratio of the theoretical power from the turbine to the theoretical power required for the compressor is equal to the ratio of the absolute temperature at nozzle inlet to the theoretical absolute temperature at the end of isentropic air compression.

A test of the Neuchatel gas turbine is cited later, and its figures should be before every gas-turbine student. The ratio of the theoretical powers in test No. 2 is 1.83 and the ratio of the absolute temperatures is 1.82 which shows the character of the approximation here being made. With 70 F inlet temperature the compressor isentropic final temperature is 802 F abs. Suppose the temperature at the turbine nozzle inlet is 1946 F. This is a high temperature, but within the bounds of possibility. The absolute temperature at the nozzle inlet then is 2406 F. The ratio of absolute temperatures, which is approximately the ratio of the theoretical powers, then is 3, that is, the theoretical power for the compressor is 33 per cent of the theoretical turbine power.

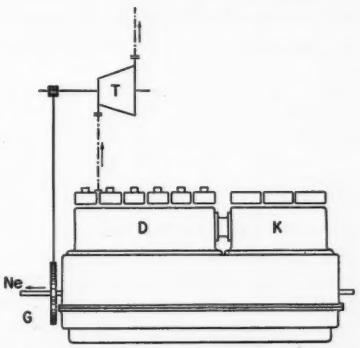


Fig. 2. Highly supercharged two-stroke Diesel engine, with direct-connected reciprocating compressor and mechanical transmission between exhaust-gas turbine and Diesel engine. Turbine is coupled by gearing, shown here as chain gear, to engine crankshaft. D—Diesel engine; E—compressor; T—exhaust-gas turbine; G—gear; Ne—effective output at shaft

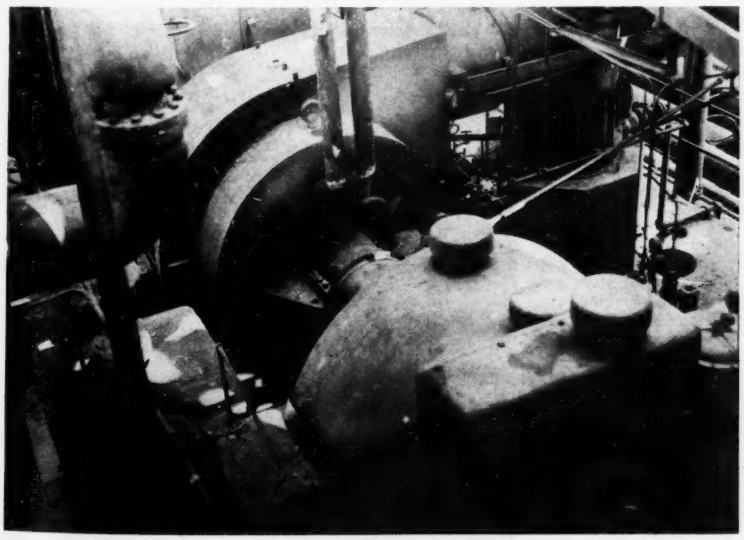


Fig. 1. G.E. gas turbine operating on 1000-F combustion products at Oleum, Calif., plant of Union Oil Co.

Using the efficiencies of the Neuchatel gas-turbine test, the compressor efficiency is about 85 per cent, so the actual power for the compressor is 0.33/0.85 or 39 per cent of the theoretical turbine power. With 88 per cent efficiency of the turbine, the actual power from the turbine is 88 per cent of the turbine theoretical power. That is to say, the net power is

*Second part of abstract of paper entitled Gas Turbines and Turbosuperchargers presented December 1, 1943, before Annual Meeting ASME, New York City. Part I published in POWER PLANT ENGINEERING, February, 1944.

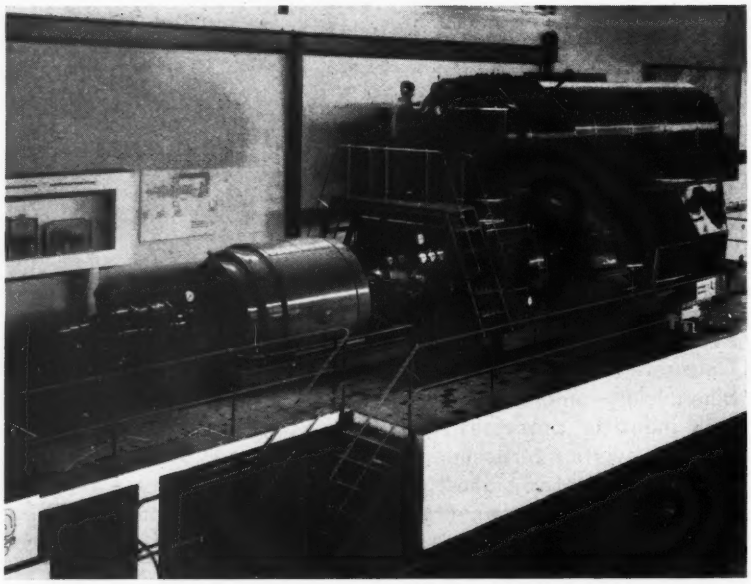


Fig. 3. This gas-turbine generating unit, installed in a bomb-proof shelter at Neuchatel, Switzerland; develops approximately 4000 kw of net power

(0.88—0.39)/0.88 or 55 per cent of the turbine actual power. This figure is far beyond the 1907 possibility and is on the basis of all of the progress since that date, and then some. The Neuchatel gas-turbine test has a turbine temperature of about 1000 F, much lower than the 1946 F previously assumed, so that the net power only is about 27 per cent of the actual turbine power. But while in 1907 we hoped for everything that since has been shown by the Neuchatel test, the turbosupercharger, and all the other progress, the actual reality was far different.

So the General Electric gas-turbine research continued until a fuel consumption was in sight, of 4 lb of kerosene per net hphr. At that time good oil engines were using 1 lb of oil per net hphr. Even though it seemed certain that the clouds cast upon the operation of a gas-turbine nozzle had no basis in fact, it was thought desirable to measure actual spouting velocity of products of combustion. So the combustion chamber was flexibly mounted and nozzle reaction measured.

Similar nozzle-reaction experiments later were conducted by Glenn B. Warren with similar results. Recently, Dr. Chester W. Smith and other General Electric engineers have worked on tables of available energy of products of combustion for turbosuperchargers, with exact values of specific heat. But probably more work needs to be done to get exact available energies for gas turbines.

All of the General Electric gas-turbine work was conducted with temperatures possible with materials then known, and no vision was had of the possibilities which the turbosupercharger work to be described later has developed. So the temperatures were kept low by air excess or water injection, both resulting in inefficiencies. No way then seemed open to do better, and so the gas-turbine part of the research was postponed, but with vigorous commercial work on centrifugal compressors, as already mentioned.

Explosive and Continuous Combustion

The gas turbine had been expected to replace the reciprocating internal-combustion engine, and so there was an early idea that it was essential gas-turbine combustion should be similar. This led to a number of proposals for explosion gas turbines, as in the case of LePontois. A German engineer, Hans Holzwarth, has made extensive publications on such apparatus through many years. But there seems doubt as to whether he ever reported performance of a complete machine which compressed its own air.

Opposed to these explosion gas turbines are those based on continuous combustion under pressure. The possibility of efficient operation once was doubted. Since then many continuous combustion chambers have been operated with complete success, so demonstration on this point no longer is needed.

Gas-Turbine Prime Movers

Thus the gas-turbine idea has been kept alive through many years, with some partial approaches, as will be discussed later, but always with the hope among enthusiasts that some day it will compete with such high efficiency prime movers as the modern steam central station or the internal-combustion reciprocating engine.

The town of Neuchatel, Switzerland, arranged for an emergency power plant, in a bomb-proof place, as a war protection, and a 4000-kw gas-turbine plant was constructed. An efficiency test of this in actual operation was published by the famous Ger-

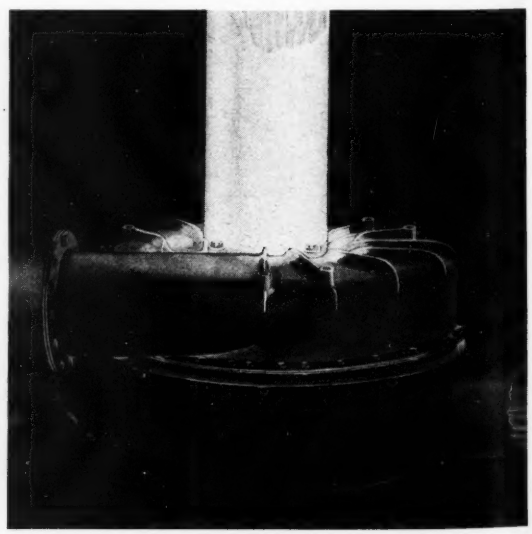


Fig. 4. View of a G.E. turbosupercharger, operating on test under stratosphere conditions; air at –50 F enters compressor at top, frosting pipe; exhaust from engine enters turbine nozzle box from right at temperature high enough to heat pipe incipient white and nozzle box from white to red. Taken from a water color drawn from actual unit being tested

man turbine authority, then in his old age, Dr. A. Stodola, and seems to be a worth-while operation of a gas-turbine prime mover. It shows a thermal efficiency of 16 to 17 per cent at about 1000 F.

Recently actual test results have been published of the gas-turbine locomotive mentioned by Dr. Meyer as being constructed by Brown-Boveri for the Swiss Federal Railway, which seems ready for actual use. This is another operation of the sort of gas-turbine prime mover which has been sought through many years.

Partial Gas-Turbine Cycles

There are some gas turbines in extensive commercial operation, but not as complete prime movers. An early one is the gas turbine in extensive use by the Brown-Boveri Co. and others, to supply compressed air to the supercharged combustion chambers of the steam boilers for the Brown-Boveri Velox System and other similar systems.

Many partial gas-turbine cycles have been in successful operation for years, for oil refineries, built by the Allis-Chalmers Mfg. Co., which has some connection with Brown-Boveri. Outfits of a similar sort have been constructed or planned by the General Electric Co. and others.

All of the foregoing outfits are planned for the comparatively moderate temperature of about 1000 F. They use gases produced in the course of chemical and combustion operations, and drive air compressors. They do not have the obligation imposed on a gas-turbine prime mover, which has to produce net power as well as to compress the air which produces by combustion or otherwise the fluid which drives the turbine. But they are definite steps in gas-turbine progress.

In the meantime, temperatures used in steam turbines have been rising, and many are operating at temperatures around 900 to 1000 F and show present general use of such temperatures. But to a "red-hot" enthusiast who lathers himself into a white heat in trying to get white-hot gas turbines, a mere 900 F is almost a refrigerator temperature. But it is a step on the way.

Reciprocating Engines Exhausting into Gas Turbines

There are those who argue that for moderate powers, the upper part of the high-temperature range which is necessary for high prime-mover efficiencies can best be handled in a reciprocating engine, with the gas turbine to take the gases at a reduced temperature and carry the expansion to the limit. But whether or not this is going to be the ultimate is a question.

Cycle Arrangements

(a) Diesel-Turbine Cycle.— An early system was proposed by the engineer Johannsen of Götaverken, a prominent ship-building concern of Gothenburg, Sweden. A two-cycle Diesel engine exhausts at the high back pressure of about 4 atm and drives only its scavenging reciprocating air compressor, which is mounted on its crankshaft. The exhaust, cooled by a large amount of scavenging air, proceeds to the turbine, all of whose power is net. Sulzer Brothers, Ltd., of Winterthur, Switzerland, has been working on various modifications of the same general plan. Free pistons also have been proposed.

(b) Divided-Manifold Cycle.— Dr. Alfred Büchi of Winterthur, Switzerland, long has worked on turbosuperchargers and, as discussed next, made a very early proposal for the modern type with constant pressure, since used by others. Büchi and his associates, Brown-Boveri & Co., also have used what may be called a divided manifold. This has a Diesel engine with the usual sort of turbosupercharger, next discussed, except that nozzle-box sections and exhaust-manifold passages are divided so that a given exhaust passage into which exhaust is proceeding from one cylinder is never connected to another cylinder which is at the end of exhaust and beginning of intake. This cycle also has been used by Rateau.

In most cases, the cycle is used with Diesel engines having low exhaust temperatures and low speeds, as compared with aviation engines. The divided-manifold sections are of such reduced area as to avoid sudden drop of exhaust pressure. Furthermore, each cylinder exhausts by itself until its exhaust pressure dies out. So there is a variable nozzle-spouting velocity, which does not match the turbine-wheel speed during the entire time and thus causes a loss. The system of interlocking sections of the exhaust manifold connected to the different cylinders causes appreciable complexity.

Turbosuperchargers

The constant-pressure-turbosupercharger cycle first began practical use with high-altitude aviation. During World War I Dr. William F. Durand was chairman of the National Advisory Committee for Aeronautics, and in the course of one of his duties of examination of schemes for aviation improvement, there came to him in the fall of 1917 a plan of the French engineer, Rateau, for using a turbine wheel driven by the products of combustion of the engine exhaust, at constant pressure, to drive a centrifugal compressor to do the supercharging. Dr. Durand had been a professor at Sibley College, Cornell University, in 1901, and he remembered the black smoke from the gas-turbine research. So he asked General Electric to undertake turbosupercharger development in the United States. General Electric engineers had their own ideas about design details from their experience with gas turbines, steam turbines, and centrifugal compressors and so started a development entirely independent of Rateau, which has continued to this day, with production successively increasing on account of the present war.

Work in 1918

The first General Electric turbosupercharger was constructed with wartime speed and was assembled on one of the Liberty motors then being used, by the U. S. Army Air Corps, McCook Field, Dayton, Ohio, in May, 1918. It was operated there so far as possible at sea level and then tested at the 14,000-ft summit of Pike's Peak, Colo.

Rateau's turbosupercharger development in France continued for a while after World War I and developments were started in England and Germany. But the resources devoted to the project abroad do not seem to have been sufficient to bring it to a state that warranted continuation.

The principal interest that the turbosupercharger has in connection with the gas-turbine problem is its development of a turbine to operate at high temperatures of products of combustion. It is true that the aviation turbosupercharger has only short-time operation at extreme conditions and does not have to meet the conditions of continuous operation in a power plant. Nevertheless, many problems have been solved, due to the impetus of World War II, which advance the prospects of a gas turbine as a

(*Continued on page* 138)

Savings in Return Condensate

Manufactured equipment is now available for reclaiming heat from boiler blowdown and condensate from process . . . System devised for use in process plant . . . Chart for determining percentage of flash steam in hot water . . . Method of calculating savings worked out in detail

By ANTHONY A. FETTE

STEAM flashed from condensate has a heat value about which much has been written, and manufacturers have developed and put on the market types of equipment which assure great savings in returning condensate to boilers at temperatures considerably higher than the boiling point of water at atmospheric pressure. In modern plants, also, heat exchangers are employed to recover considerable heat from water blown down from boilers in operation.

These two methods of conserving heat are now being used, under the writer's supervision, in a plant where considerable exhaust steam is used for process work. The arrangement and equipment are illustrated in the accompanying diagram.

In this plant about 5,000,000 lb of steam are generated per day. Of this steam, the dryhouse uses an average of over 1,000,000 lb besides a considerable amount of exhaust steam. An accumulating tank was installed to receive the discharge from the continuous blowdown system of the nine boilers in service. A similar tank was installed in the dryhouse and the flash steam feeds into the exhaust steam line for process work.

After the system was in service on the continuous blowdown, a condensate meter was installed to measure the amount of discharge from the tank which gave a means of determining the value of the heat recovery system. The plant has nine boilers and sometimes all of them are in service, but usually one is down for repair and maintenance work, and while the test reported here was made, No. 9 boiler was out of service for repair.

When the meter was put into service, it was found to be too small to measure the whole amount of condensate, hence, the measurements were made in groups of two and three boilers at a time and the remainder were shut off. Boilers Nos. 1, 2 and 3 are rated at 225 hp and the others at 500 hp each. The test was conducted for a period of a day and a half as shown by the test data given herewith.

By means of the accompanying chart, Fig. 2, the percentages of condensate which flash into steam under different pressure conditions may readily be determined. Under the conditions of this test, the continuous blowdown is illustrated by the guide line designated A—140 lb initial pressure of blowdown water from the boiler, relieved at a terminal pressure of 10 lb will have 13 per cent of its weight flashed into steam. Similarly the conditions at the dryhouse are determined by the guide line B. Guide line C is for the end condition which at present vents to the atmosphere but the heat available here may be utilized in the near future.

The live steam to the dryhouse is measured by a steam flow meter and has a pressure drop of 15 lb. The boilers carry a pressure of 140 lb and the live steam used in the drumdryers is at 110 psi. The amount of the continuous blowdown of each boiler is increased or decreased as dictated by the amount of concentration of impurities in the boiler water, which is determined daily. These conditions are about the average for normal operation. The drumdryers carry 110 psi right into the discharge traps and the bypasses around traps are usually partly open to insure against any accumulation of condensate in the dryers and also to insure dry steam in the dryers.

In the following paragraphs are given the results of the test run to determine the amount of the continuous blowdown, and the method the author has used to determine the savings which have been effected by the use of flash steam in this particular plant.

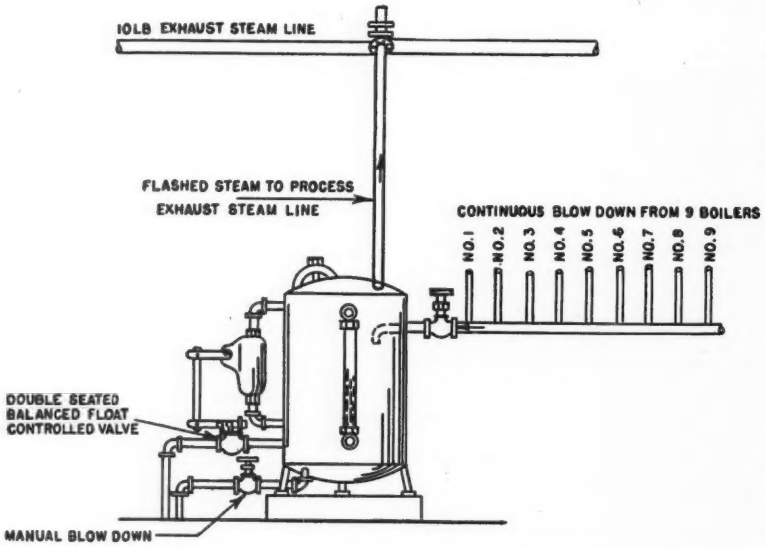


Fig. 1. Arrangement of equipment designed for flashing steam from boiler blowdown water into process line

Test Run on Continuous Blowdown December 2, 1943

Boilers Nos. 1, 2 and 3	
12:45 to 1:45	3300 lb
1:45 to 2:45	3310 lb
2:45 to 3:40	3290 lb
Average per hour	3300 lb
Boilers Nos. 4, 5 and 6	
9:30 to 10:30	5475 lb
10:30 to 11:30	5450 lb
11:30 to 12:30	5500 lb
Average per hour	5475 lb
Boilers Nos. 7 and 8	
1:30 to 2:30	4050 lb
2:30 to 3:30	3950 lb
3:30 to 4:30	4000 lb
Average per hour	4000 lb
Total hourly metered blowdown	12,775 lb

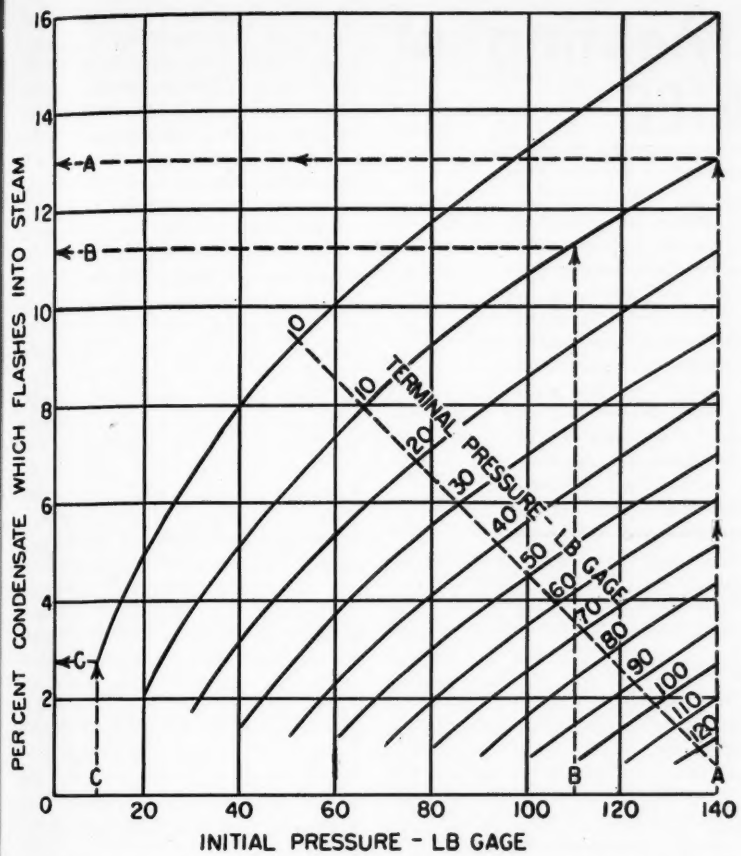


Fig. 2. Chart for indicating the percentage of water flashed into steam in dropping from high to low pressure. The water is at the temperature corresponding to boiling at the pressure used on chart

Continuous Blowdown on Boilers Under Conditions Indicated by A, Fig. 2

Total metered hourly blowdown, 12,775 lb, times hours in day, 24, equals 306,600 lb per day. This is 87 per cent of the total blowdown since 13 per cent flashed into steam prior to metering and passed off into the exhaust steam line for process work. To find the total initial weight of blowdown water to the tank, divide 306,600 by 87 and multiply by 100, which gives 352,414 lb. The amount flashed into steam is then 352,414 minus 306,600 or 45,814 lb.

Plant records show that the average total cost of steam during the past 10 months was $0.389213 per 1000 lb, or practically 40 cents. Using this cost figure in the calculations, the savings may be estimated as follows:

45,814 ÷ 1000 × 0.40 = $18.33 per day

18.33 × 365 = $6,690.45 savings per year by having continuous blowdown to a flash tank instead of direct to sewer at atmospheric pressure.

Dryhouse at Conditions Indicated at B, Fig. 2

Live steam used at dryhouse at present as recorded by a steam flow meter amounts to 1,346,117 lb per day. In the flash tank the returns are reduced in pressure from 110 psi to 10 psi. Part of the condensate is thus flashed into steam, the percentage indicated on the chart, Fig. 2, being 11.2. Using these figures in the following calculation gives:

1,346,117 × 0.112 = 150,765 lb of condensate flashed into steam at 10 lb pressure for process use.

150,765 ÷ 1000 × 0.40 (cost of steam per 1000 lb) = $60.30 which represents the savings per day.

Estimating that 15 days may be lost during the year due to mechanical failures, the operating days during a year would be 350. Thus:

350 × 60.30 = $21,105.00 estimated saving per year by flashing dryhouse condensate returns.

Continuous Blowdown Under Conditions Indicated at C, Fig. 2

In discharging the tank to atmosphere, the pressure drops from 10 psi to 0 and thus flashes 2.8 per cent of its weight to steam. From figures given above:

306,600 × 0.028 = 8,584.8 lb water flashes to steam in the sewer per day under these conditions.

8,584.8 ÷ 1000 × 0.40 (cost of steam per 1000 lb) = $3.434 per day, and this multiplied by 365 gives $1,253.41 as the amount that could be saved by employing a heat exchanger on the discharge to the sewer.

Dryhouse Under Conditions Indicated at C, Fig. 2

The amount of condensate coming to the hotwell under these conditions is 1,346,117 — 150,765 or 1,195,352 lb. When vented to atmosphere 1,195,352 × 0.028 or 33,479.86 lb per day flash to steam which escapes to atmosphere. If used this would amount to 33,480 ÷ 1000 × 0.40 (cost of steam per 1000 lb) or $13.39 saving per day; or 13.39 × 350 = $4,686.50 could be saved by the use of a heat exchanger on the vent to atmosphere on returns from the dryhouse.

Summary

Saved or diverted to process work—

$ 6,690.45 from continuous boiler blowdown

21,105.00 from dryhouse returns

$27,795.45 combined savings from both the above.

Possible savings that could still be made by heat transfer in vent to atmosphere—

$ 1,253.41 from continuous blowdown

4,686.50 from dryhouse

$ 5,939.91 from both the above

$27,795.45 is the estimated saving at present

$33,735.36 could be total saving.

Note:—Mr. Fette has given in detail his method of estimating savings due to the use of means for reclaiming heat from flash steam. In his calculations he places a value of 40 cents for 1000 lb of steam regardless of the pressure of the steam. This high value may be questioned for steam in his cycle at 110, 10 and 0 psi. Readers are cautioned to take this factor into consideration when making estimates of possible savings in their own plants.—Editor.

The Winter Meeting of The AIEE

Over 1200 electrical engineers attend annual winter technical meeting of the American Institute of Electrical Engineers in New York. Many new developments disclosed. Feature of the meeting was a display of captured enemy communication equipment and an address on enemy communications equipment by Major General Colton of the U. S. Signal Corps. Session on standardization of turbogenerator characteristics of importance to power men. New crossbar toll switching system and new automatic ticketing telephone system, newest developments of the Bell Telephone Laboratories. S. G. Hibben of Westinghouse tells of new circular fluorescent lamps. Dr. Vannevar Bush of Carnegie Institution of Washington given the Edison Medal

THE WINTER TECHNICAL MEETING of The American Institute of Electrical Engineers, held at the Engineering Societies Building in New York, January 24 to 28, covered a wide and varied range of interest and technical activity. It was attended by over 1200 members of the Institute and their guests.

It is not possible in a brief report to cover any but a small part of the various aspects of a large meeting of this kind and in what follows, we will concentrate largely on those parts of the meeting that are of interest to the power engineer. As in previous years, the technical papers and the conferences covered virtually the whole field of electrical engineering. There were sessions on communication developments, both wire and radio; on power generation and distribution; on transmission; on instruments and relaying; on electrical transportation by land, sea and air, etc. There were other conferences dealing with more general topics such as safety and education; there was one which dealt with problems in civic affairs and cooperation with other organizations. At the general session on Wednesday morning, January 26 which included the presentation of the Edison medal to Dr. Vannevar Bush, Colonel Willard Chevalier, publisher of Business Week, delivered an address entitled, "The Engineer in America's Business Future."

The Institute of Radio Engineers also held a meeting in New York on Friday and Saturday of the same week and one of the features of both meetings was a joint session on Thursday evening, January 27. This session was of unusual interest because of an address by Major General Roger B. Colton, Chief of the Engineering and Technical Service of the Signal Corps, U. S. Army, on the subject of "Enemy Army Communication Equipment." This was the first complete discussion of enemy signal apparatus made public by the Signal Corps. General Colton's address was not only extremely interesting because of what he said but it was enhanced by an exhibit of a substantial amount of captured German, Italian and Japanese telephone and radio equipment. There was also a display of some of the communication equipment used by the U. S. Signal Corps. While some of the German radio equipment was beautifully made, and some of the more recent Japanese equipment was well made, none of it was substantially better than our own. Our own equipment can be classified as second to none.

The magnitude of the communication job our armies have accomplished, the General pointed out, could be appreciated by a comparison between the money spent for signal equipment in this war and World War I. The largest annual appropriation for the signal service of the Army during World War I was $83,000,000 while during the fiscal year ending June 30, 1943, the appropriation amounted to more than $5,500,000,000 — 66 times as much!

The Edison Medal this year went to Dr. Vannevar Bush, now President of the Carnegie Institution of Washington. The presentation was made at the general session on Wednesday morning by the President of the AIEE, N. E. Funk. Dr. Bush is noted for his many scientific achievements in the electrical field but his principal fame, perhaps, extends from his development of mathematical analyzers, principally the differential analyzer at the Massachusetts Institute of Technology.

Standardization of Turbo-Generator Characteristics

Of considerable importance to those engineers engaged in the operation or design of turbo generators, was the conference on turbo-generator characteristics. This session began with the presentation of a report by the joint AIEE-ASME Committee on turbogenerators and this was followed by discussion from the floor.

The AIEE-ASME Joint Committee on turbo-generators was formed to standardize the important characteristics of turbo-generators in sizes of 10,000 kw and above. The ASME group has recommended five standard turbine ratings of 12,500, 20,000, 30,000, 40,000, and 60,000 kw operating at 3600 rpm. Each of these units will have a guaranteed capacity of 110 per cent of their nominal output values. This guaranteed capacity will be available whenever the machine is in normal condition and operating under normal steam conditions.

Offhand it might seem simple enough to design generators with characteristics to conform to the turbine capacities suggested but the problem is complicated by various factors. The problem concerns the standardization of machines that may be built by the tens per year and not by the thousands or millions, as in the case of many standardized articles. Furthermore, most of them will be used alongside or electrically connected in parallel with many older but still serviceable units, hence there is required a duplication of some characteristics (voltage, phase, frequency, for example) that introduce complications not involved in the building of a standardized automobile or electric appliance.

Data for this discussion were obtained by sending a questionnaire to members of the AIEE Committe on Electrical Machinery, the AIEE Committee on Power Generation, and the EEI Electrical Equipment Committee. Replies were received from over 35 members of these various committees with information applying to over 15,000,000 kw of installed capacity.

In a large number of turbogenerators built in the recent past, it has been quite usual practice to

supply a generator with 80 per cent power factor rating but a turbine having a maximum capability of 125 per cent of the generator nameplate kilowatt rating. Thus the unit could carry full kva at unity power factor. In some cases the machines have been re-rated to this maximum output which was available only at high power factor. In other instances the surplus capacity above nameplate rating has been the margin to carry sudden swings in load and to offset some of the factors that temporarily derate a turbo-generator, such as steam conditions not normal, poor vacuum, or dirty turbine. The change from a 25 per cent margin to a 10 per cent margin must be considered for its effect on size of generator and general system planning problems.

The report of this committee was intended not to make specific recommendations at this time but merely to present data that would stimulate discussion. There is, for example, the question, "What is meant by turbine rating?" Is it the instantaneous output the unit is capable of delivering or is it the average energy output, say in kwhr per hr? This latter point of view is the one that is of real interest to system operators. The turbines have a definite torque capability which limits their ability to take increases in load. Generators, however, under normal conditions have sufficient thermal capacity to take sudden short-time increases in load.

It should be evident, merely from the few aspects of the problem outlined above, that it is not a simple one and it was with these conditions in mind that the committee asked for a general discussion. Such a discussion is essential for a clear understanding of the problems. The discussion was confined to three basic characteristics of the generators: (1) ratio of generator rating to turbine rating, (2) power factor rating, and (3) short-circuit ratio.

Much of the discussion on the report at the meeting was in regard to the power factor rating. The question of power factor seems to be the most important single factor, and the discussion of it was extremely interesting. Much depended upon the particular practice used by the individual discussor. Mr. Sills of the Public Service Electric Co., for example, said that his company was one of the few large companies which did not have a power factor clause in their contract; there is no inducement for their customers to improve power factor. Yet the power factor of the load runs 91 per cent on peaks, 89 per cent on sub-peaks and 86 per cent minimum. This high power factor, he said, was brought about largely by the installation of capacitors and condensers, by the company, not the customer. There were many questions to be answered he said. How much wattless power should be carried on the generator, how much on synchronous condensers, how much shall the customer pay for wattless power? Mr. Sills believes that much of the data in the report results from rate structure.

Mr. Dean of the Detroit Edison Co. made a number of pertinent remarks on the subject. A generator, he said, might represent an investment of 5 or 10 dollars out of a total station cost of, say, $100 per kw. By skimping in the design of a generator one might save perhaps 10 to 15 per cent of that $5.00. While they (Detroit Edison) were in favor of standardization they would be reluctant to buy machines which were skimped—they were inclined to buy low power factor generators. The low power factor generators on their system, he said, came in very handy in carrying some of the war loads. The field of the generator, Mr. Dean pointed out, is usually the limiting feature of the machine, it heats up most rapidly.

It can be readily understood from these few comments on the discussion that the problem of generator standardization is a complicated one, that will need the cooperation of all interested parties if it is to be solved satisfactorily.

Industrial Power Applications

Perhaps the next session of greatest interest to power engineers was the conference on industrial power applications held on Thursday, Jan. 27. This conference was, for the greater part, a practical discussion of the design and operation of power distribution systems in industrial plants, though it included also such papers as the one by Palmer and Leigh on Inverter Action on Reversing of Thyratron-Motor Control.

A paper at this session that attracted considerable attention was one by L. D. Peterman of Ford, Bacon & Davis, on Short Circuits and Breakers. This described experience with short circuits and emphasized the co-ordination between fuses and circuit breakers. Since the paper had to do primarily with circuits of 600 v and less, the short circuits discussed were only those of low resistance which develop from defective or damaged equipment, not overloads.

Mr. Peterman pointed out that the application of protective devices involves different principles for various types of circuits. Two of the principal types of circuits

Fig. 1. Typical group between sessions. L. to R. R. C. Gorham, University of Pittsburgh; E. R. Whitehead, Duquesne Light Co.; J. R. North, Commonwealth and Southern Corp.; G. D. McCann, Westinghouse Elec. & Mfg. Co.

which require differing treatment are: 1. The simple branch circuit supplying a single current consuming device, and 2. A feeder which supplies a group of branch circuits. These two types of circuits are illustrated in Fig. 2.

The protective device of the branch circuit at "A" is simple in application and is governed by well established rules. In most cases the rules of the National Electric Code govern. In general the trip rating of the protective device matches the rating of the wire, but the code does not distinguish between a time delay device which may permit a temperature rise of 10 deg in the wire before opening and an instantaneous device which permits almost no heating of the wire.

The protective device in the feeder at "B" also is applied usually to match the current rating of the wire. It should open the circuit if a fault develops in the feeder conductor or in the branch circuit protective devices, but it should not open for a fault which develops in the branch circuit. As Mr. Peterman pointed out, this action does not always take place. In many cases where faults develop on a branch circuit, the feeder breakers trip off, thus shutting down a large part of the plant. This brings up the problem of providing proper selectivity between feeder protection and branch circuit protection.

Mr. Peterman indicated that utility engineers have grappled with this same problem for years on high voltage circuits and that they had achieved a high degree of success by the use of various types of relays and oil circuit breakers. Yet, in the low voltage field, where direct acting breakers are available having inherently greater operating speed than any high speed relay and oil breaker combination, no real attack has been made on the problem of securing selectivity and adequate coordination.

In summing up his remarks, Mr. Peterman said that the most urgent need at the moment is adjustable trip ratings for all types of breakers. When an engineer buys switchgear for a new industrial plant he seldom knows the size of his feeders. If he buys a 300 amp breaker he is sure to wish later that he had purchased a 400 amp unit. If he changes to 400 amp, he may find that a few ought to be 600 amp. A 100 amp breaker, said Mr. Peterman, ought to be adjustable between 5 and 100 amp. The field for breakers is limited until that can be done.

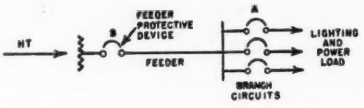


Fig. 2. Diagram of feeder and branch circuits discussed by L. C. Peterman at the Industrial Power Application session

Other papers at this session dealt with lightning protection for industrial equipment, design of plant distribution systems, induction heating applications and a description of the Dodge-Chicago Plant's distribution scheme with airplane engine power recovery circuits. The session was continued in the afternoon with other papers of the same general character.

There was great interest in the paper on induction heating applications referred to above, which was presented by H. E. Somes, Chief Engineer, Budd Induction Heating, Inc., of Detroit, Mich. Mr. Somes pointed out that they have in their Detroit plant what was probably the largest induction heating installation in the world. This consists of 62 heaters powered by 7200 kw of motor generators having frequencies from 3000 to 9600 cycles. They had, he said, processed approximately 20 million pieces aggregating 104,000 tons of forgings for ordnance purposes, using electro-magnetic induction heating. It has been their experience that the savings of material and the reduced cost of scale removal offset to a large degree the cost of electric power. In other words, while the heating cost may range from $3.00 to $5.00 per ton for heating to forging temperatures, nevertheless the reduction of billet weight which is found to be between 3 per cent and 5 per cent, and the lowered cost of scale removal together with the increase in die life makes for a substantial reduction in the production cost.

Lighting Developments

An interesting demonstration was given at the conference on Lighting, by S. G. Hibben, Director of Applied Lighting, Westinghouse Electric & Mfg. Co. Mr. Hibben showed the various new types of lighting developed in recent years. Among other new developments Mr. Hibben described new circular fluorescent lamps that had been made recently. Up to the present time, it has been possible to make fluorescent lamps only in the straight tubular form. No way could be devised to apply the phosphor coating to the inside of circular or other curved tubes. Any attempt to make such lamps resulted in an unequal distribution of the phosphor coating on the inside of the tubes. Now, however, the difficulties in this direction have been largely overcome by the introduction of the phosphor material into the composition of the glass itself. By the development of a new type of glass which fluoresces under the action of ultra-violet radiation, it becomes possible to make fluorescent lamps in any shape desired.

New Developments in Communication

Several interesting developments in the communication field were described at the session on Communication and Electronics. One of these was the new Crossbar Toll Switching System recently placed in operation in the Philadelphia area by the Bell System. This system was described in a paper presented by L. G. Abraham, A. J. Busch and F. F. Shipley, all of the Bell Telephone Laboratories. The system was designed by the engineers of the Bell Laboratories for large toll centers where most of the central offices are of the panel and crossbar types. The Philadelphia installation was designed before the war. Even then it was apparent that a mechanical switching system was urgently needed to secure faster and more economical switching. War conditions produced an abnormal growth in toll traffic that accentuated the need for the new equipment. The system was, therefore, installed as rapidly as the heavy load of war work on the engineering and manufacturing organizations of the Bell system would permit.

The function of toll switching equipment is to provide connections that will enable subscribers to converse with other subscribers in localities too distant to be reached over their own network. If the toll areas in which the calling and called subscribers are located have a sufficient community of interest there may be direct circuits between them, and at each terminal there will be a switched connection to a local office. The system cannot be described briefly but it makes use of the crossbar switch which has been so successful in local offices since 1939. It offers many improvements over the switching equipment used in the large toll centers in the past. Transmission objectives are met with greater ease and substantial economies are made in the outside plant and repeater equipment.

Another advance in the art of wire telephony was described in a

paper by O. A. Friend of the Bell Telephone Laboratories. This is a new system of automatic ticketing of telephone calls, which has recently been placed in commercial service in the Bell System, the initial installation being in Culver City, adjoining Los Angeles, Calif. This system enables telephone users in a metropolitan area to dial for themselves their calls to nearby points instead of placing them with an operator. It has the distinctive feature that it automatically prepares an individual printed ticket showing the information needed for charging the call.

While automatic ticketing is new in this country, some forms have been in use in Europe for a number of years. The system just developed by the Bell Laboratories in some respects resembles and in other respects differs from automatic ticketing systems developed abroad and used commercially in several networks in Belgium prior to the war.

Aircraft Electrical Systems

While aircraft power plants are far removed from the interests of the average power engineer, some of the papers on aircraft power systems presented at the meeting were of interest because the systems described were so different. Intensive development work is now underway on electrical systems of tomorrow's aircraft. In general, it seems that alternating current has advantages over direct current for airplane work. W. K. Boice and L. G. Levoy, both of General Electric, pointed out that an extensive line of 400 cycle aircraft equipment, including generators, regulators, switchgear, control, transformers, motors, instruments, etc., has already been developed. At the same time they pointed out that present indications do not point to the use of a-c in all types of planes. The 27-v, d-c electrical systems used in Flying Fortresses and Liberators is performing in a most satisfactory manner. However, the size, performance, and electrical load requirements of proposed new planes are such that the 27-v, d-c system will not be adequate or efficient from the standpoint of weight, thus making it necessary to consider new types of systems.

In view of the work that has been and is being done, the aircraft industry will have at its disposal electrical systems at several voltage levels. These include 6 or 12 v, d-c systems for very small or private planes; 27 v, d-c systems for small and medium size planes; 27/120 v, d-c systems for large, medium altitude cargo or transport planes; and 120/208 v, 400 cycle, a-c systems for large, high altitude long range planes.

Fig. 3. W. K. Boice (left) and L. G. Levoy, G. E. aircraft application engineers shown with the new 400 cycle, a-c generator recently developed by G. E. for aircraft electrical systems

New Magnetic Alloys

The properties and characteristics of new permanent magnet alloys which increase the sensitivity of small panel type instruments beyond the possibilities of the chrome and tungsten alloy steels previously used for permanent magnets, was the subject of a paper delivered by M. S. Wilson and J. M. Whittenton, engineers in the Electrical Instrument Section of General Electric's West Lynn Works.

This paper, "Influence of Improved Magnetic Alloys on Design Trends of Electrical Instruments," takes the position that the design trend of electrical indicating instruments has been greatly influenced by the use of permanent magnet alloys which have been developed during recent years. The authors stated that for given sensitivities, instruments have been made available which are more sturdy and reliable, and that instruments of higher sensitivity have been made possible by the use of the newer alloys. Also, relatively higher coercive force and high residual materials are now available that are readily machined and use a minimum of critical materials. All of these are factors which are of particular importance in designs for wartime application.

For the past 15 to 20 yr, cobalt steel permanent magnets have been used in instruments, providing a means of producing higher sensitivities. This material has been used in forged and cast forms and is most attractive from the standpoint of high coercive force of about 210 with total energy of 900,000. However, its inherent high cost limits its use primarily to the higher sensitivity instruments where the chrome and tungsten steels are unsatisfactory.

Also pointed out were the great advances which have been made recently in strength of permanent magnet materials by the development of the aluminum-nickel-cobalt iron (alnico) alloys. These are of particular interest to the electrical instrument designer due to their high values of coercive force and available energy.

These magnets are characterized in electrical instrument design by their relatively large cross section and short length which produce a given flux across a given air gap ration. They are highly resistant to demagnetizing fields due to their high coercive force. Alnico materials have been widely used as instrument magnets and their manu-

(*Continued on Page* 120)

Corrosion in Condensate Piping*

Dissolved CO_2 in condensate produces serious corrosion . . . Boiler water treatment to give CO_2-free steam needed . . . Status of problem reviewed . . . Presence of CO_2 in condensate investigated

By LEO F. COLLINS,
Chemist,
Detroit Edison Co.

STUDIES made during the last few years show that even small concentrations of CO_2 dissolved in condensate may cause serious corrosion if other contributing factors are optimum, that in steam condensing apparatus stratification of CO_2 and steam occur with most of the CO_2 in the gas phase closest to the condensate. It is felt that this stratification accounts for the fact that frequently more CO_2 is found dissolved in condensate than theoretical calculations predict.

It is indicated that fundamental research, looking to the development of a water treating method by which CO_2-free steam can be produced upon a commercial basis, when carbonate-bearing boiler feedwaters are used, is the acknowledged want.

In a series of articles published about 4 yr ago, the results of some 15 yr of study of the problems of corrosion in steam heating systems were presented.[1] At that time, however, it was noted that the studies were still being pursued because satisfactory answers to certain phases had not been obtained. Once again, it must be noted that studies are still in progress for the same reason.

Resume of Previously Published Data

It is felt that the most significant disclosure of the previous publication was that carbon dioxide dissolved in otherwise pure condensate is, of itself, capable of producing serious corrosion. A family of curves was presented, correlating corrosion with the CO_2 concentration of the condensate and the velocity of flow of condensate through the experimental apparatus.

For academic reasons, these data were given further study. As a result, it was found that they will all correlate around a single curve if corrosion is plotted against velocity of flow of carbonic acid passing through the experimental apparatus in unit time. Such a plot is shown in Fig. 1. It will be seen that the values on the abscissa are the product, CO_2 concentration of the condensate multiplied by the

*Abstract of paper presented at Water Conference in Pittsburgh in November, '43.
[1]See List of References at end of the paper.

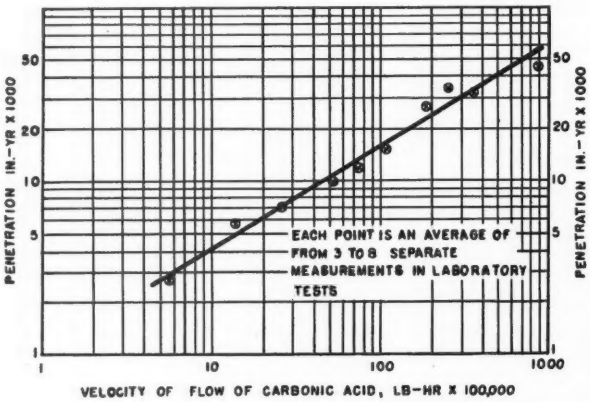


Fig. 1. Curve of condensate corrosion rate

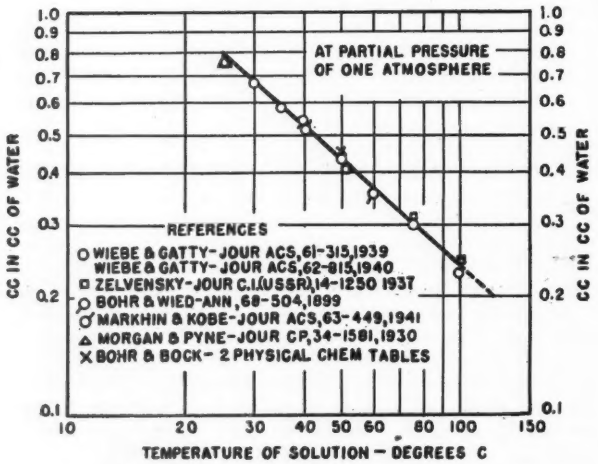
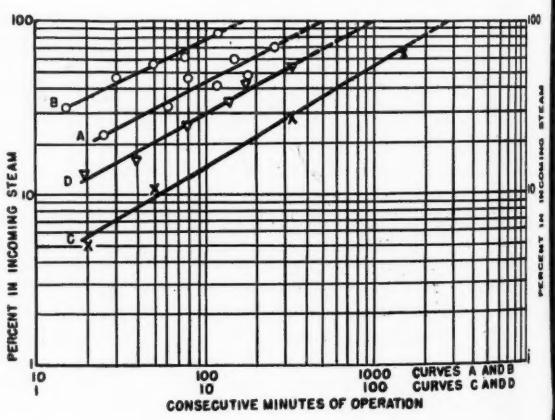


Fig. 2. Solubility of CO_2 in pure water



KEY

CURVE		A	B	C	D
CONDENSER		1	1	2	2
CONDENSING RATE LB PER HR AT 5 LB GAGE		3	7	100	200
CO_2 IN INCOMING STEAM PARTS PER MILLION BY WEIGHT		18	18	38	23
TOTAL CO_2 TO SYSTEM LB PER HR PER CU IN. STEAM SPACE X 10^6		18	43	75	90
TIME TO REACH EQUILIBRIUM MINUTES, APPROXIMATE	CALC	1100	500	700	295
	EXP	500	170	280	100

Fig. 4. Curves of CO_2 dissolved in condensates

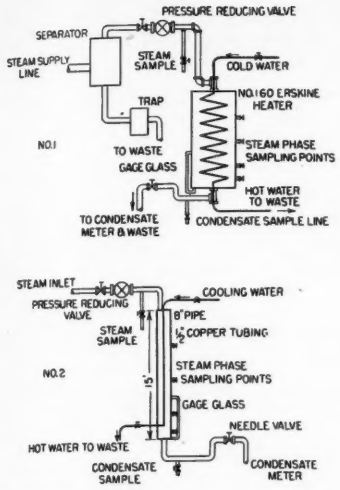


Fig. 3. Arrangements of condensers No. 1 and No. 2 used in carrying out the investigation

quantity of condensate flowing per hour. (For convenience, the results so obtained have been multiplied by 100,000.)

This curve is presented here, not in an attempt to establish a criterion for predicting corrosion rates in pipe lines carrying such quantities of dissolved carbon dioxide, but rather because of its inherent scientific value. If the correlation, in Fig. 1, is valid, then it is clear that, since carbonic acid corrosion is the resultant of a product, the potential corrosiveness of large quantities of weak carbonic acid can equal that of small quantities of a much more concentrated solution, and thus it cannot be concluded that low concentrations of CO_2 necessarily guarantee freedom from corrosion troubles.[2]

To those who perforce must use carbonate - bearing boiler feedwaters, the revelation that even small concentrations of CO_2 can cause trouble, if other contributing factors are optimum, is distressing for, as yet, no method of boiler water conditioning has been developed which can produce CO_2-free steam upon a commercial basis. Nor does the writer know of any truly zealous research work in progress aimed at such a realization.

[2]Purely chemical and physical considerations, if considered collectively, indicate that condensate containing less than about 2 ppm of CO_2 are likely to produce corrosion troubles only where exceedingly high condensation rates occur.

CO_2 in Steam Condensing Equipment

The known published data relative to the solubility of CO_2 in otherwise pure water describe the solid portion of the curve shown in Fig. 2. It seems permissible to assume, too, that the extrapolation, shown as the broken-line portion of the curve, involves no serious error.

If these data are used, and if it is assumed that gaseous CO_2 and steam form a homogeneous mixture which remains as such during the process of condensation, calculations based upon Henry's and Dalton's laws indicate that in normal operation unmeasurable quantities of CO_2 will be dissolved in the condensate formed in most steam heating equipment. Even so, it has been shown (see references 1 and 2) that condensates drained from heating systems usually contain definitely measurable quantities of gas in solution. In an attempt to resolve this paradox, the two condensers shown diagrammatically in Fig. 3 were studied.

The cooling water was introduced into the top to minimize "undercooling" of the condensate. The rate of condensation was controlled by regulating the rate of flow of the cooling water.

Results Obtained

When these units were operated so as to preclude the venting of any undissolved gas (i.e., with the condensate line flooded), the time rate of dissolution of CO_2 was found to progress as typified by the curves in Fig. 4. In the Key of Fig. 4, rows 6 and 7, is shown the calculated times required to bring about complete dissolution of the gas, based upon the assumptions enumerated above, and the experimentally determined times obtained from the curves in Fig. 4.

That the experimentally determined time is always less than that determined by calculations is explained by the fact that in the experimental units the gas phase was never found to be a homogeneous mixture of CO_2 and steam but rather was a gradient mixture with the highest CO_2 concentration being in the gas phase closest to the condensate. The data in the table typify the conditions found to exist in the gas phase. Unfortunately, an experimental technique has not yet been developed which permits simultaneous, accurate measurements of CO_2 in the gas phase and in solution in the condensate. Nor has an entirely satisfactory explanation been found to account for stratification of the gas phase.

In the present investigation, the unintentional venting of undissolved gas which occurs through the condensate line, as a result of the operation of thermostatic traps, was studied. These results are shown graphically in Fig. 5.

In general, it was found that when the amount of condensate passing through the condensate line was definitely less than that corresponding to the rating given the thermostatic traps by their manufacturers, not more than 25 per cent of the CO_2 entrained with the incoming steam was dissolved

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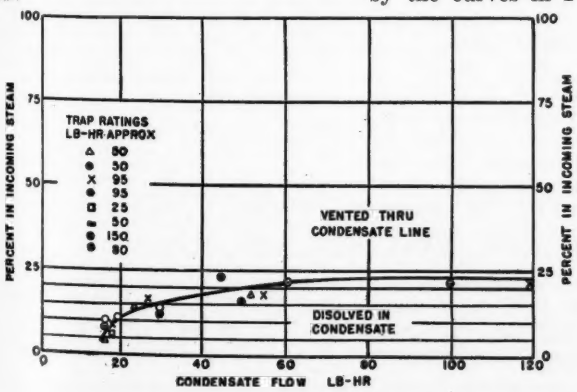

Fig. 5. Disposition of CO_2

References

(1) Corrosion in Steam Heating Systems, by Leo F. Collins and E. L. Henderson, Heating, Piping and Air Conditioning, September 1939 to May 1940, inclusive.

(2) Some Fundamental Considerations of Corrosion in Steam and Condensate Lines, by R. E. Hall and A. R. Mumford, Heating, Piping and Air Conditioning (Journal Section), November 1931.

(3) American Society for Testing Materials—Designation Bill-40T.

(4) The Measurement of Corrosion in Steam Heating Systems, unpublished report of Corrosion Subcommittee of National District Heating Association, 1934.

Navy Boilers at Shell Chemical's Butadiene Plant

Another good example of how power engineers, to save time and critical materials and get a vital plant into production quickly, did a great deal with what they could get. They installed eight old Yarrow marine boilers to generate 190 psi process steam. Four units now in operation, each generating 35,000 lb per hr. Fuels are gas or oil. Induced draft produced by twin fan Thermix stack for each pair of boilers

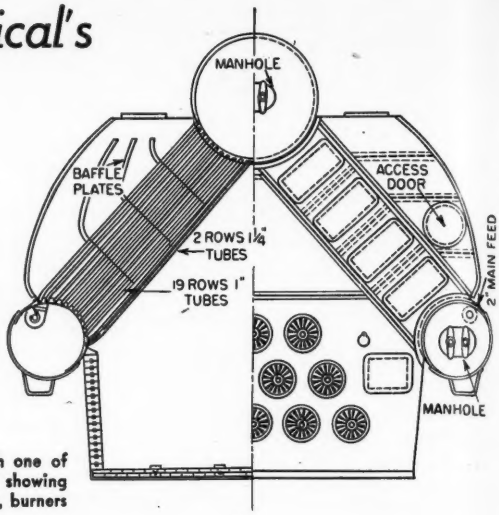

Fig. 1. Cross-section through one of Yarrow marine type boilers, showing arrangement of tubes, baffles, burners

THE DEFENSE PLANTS that are successfully fulfilling the enormous demands of our fighting forces for the tools of war have been and are utilizing the equipment and materials most readily available.* In this, Plancor 963, which is producing the butadiene from which synthetic rubber is made, is no exception. This Plancor was constructed in Torrance, Calif., by The M. W. Kellogg Co., financed by the Defense Plant Corp., and is now operated by the Shell Chemical Division of Shell Union Oil Corp., for the Rubber Reserve Co.

In order to produce 30,000 tons and purify 65,000 tons of butadiene per year, a large steam generating plant is needed. Electrical power sufficient for the pumping and lighting loads is available in Southern California; therefore, the boiler plant must supply only process steam at various temperatures, pressures, and flow rates. Thus, flexibility is much more important than high economy.

New boilers were not readily available both because of the critical materials from which they are built and because of the back-log of work of the manufacturing companies. Therefore, utilization of old boilers would save both time and critical materials.

The Navy Department had available eight marine-type Yarrow boilers removed from 1918 World War destroyers. These boilers were designed for maximum steaming rate, maximum response, and a minimum of space. They were cleaned, thoroughly inspected, and retubed where necessary.

The number of extra appurtenances added was kept to a minimum, but the extra facilities needed to meet the changed operating condition were supplied. Since the boilers supply process steam, they do not operate full condensing, therefore blowdown valves are needed to prevent the accumulation in the drums of solids from the feedwater. A fuel oil injection system was added to provide a means of destroying various plant wastes; it, also, produces useful heat. In case of gas supply failure, this injection system can be used to burn oil as a standby fuel.

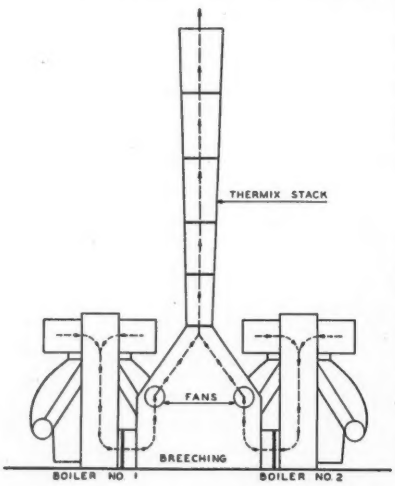

Fig. 2. How each pair of Yarrow boilers is installed with Thermix stack

Description of Boilers

The boilers were designed to produce a maximum of 100,000 lb per hr at 265 psig when operating with the boiler room of the destroyer under pressure. The two tube banks, each containing 1,661 one-inch tubes and 115 one-and-one-quarter inch tubes form the sides of an A frame. The two mud drums are 30 in. in diameter and the steam drum is 50 in. in diameter. The drums are 12 ft, 6 in. long and are of riveted construction. The tubes are rolled in and are bent to take up some thermal expansion. The mud drums are anchored and the steam drum is supported by the tubes and metal sheathing. The arrangement of tubes and drums is shown in Fig. 1.

The tubes are all in a rectangular cross-section of 2 by 11 ft and have 6,885 sq ft of surface. There are no economizers, air preheaters or baffles to pass the hot gases back and forth over the tube banks. The eleven burners give a short flame travel and the whole firing wall of the brick-lined furnace is a radiant heater. The combustion space is 800 cu ft and the heat from the hot gases must be removed in about two linear feet. Therefore, the boiler is quick steaming and has a high steam production for physical size. The four boilers now in operation

(*Continued on page* 116)

*See Steam for Dow Styrene and Goodyear Synthetic Rubber, POWER PLANT ENGINEERING, February, 1944, pp. 66-69.

The boilers weigh over 38 tons each and have minimum dimensions of 12 ft 5 in. and 17 ft. Five of the boilers were transported from San Francisco by large low-bed trucks. The other three made the transcontinental trip by railroad. Each boiler was placed on a special low-bed flat car capable of carrying 180 tons. The beds of the cars were not sufficiently rigid to give the boilers the necessary support. Therefore, each of the three beds was reinforced with special steel plates 1¼ in. thick, 10 ft wide and 20 ft long. The boilers were welded to this plate and braced with steel rods. The original loading and blocking in New Jersey required ten days because of its magnitude and difficulty.

Because of the unusually large size, a detailed study of train clearances was made and the route selected was the Erie, EJ&E, CRI&P, SP, and PE. The cars were moved only in daylight on slow local trains running under speed restrictions. In many cases it was impossible to use main lines and the cars had to be routed around cities such as Akron, Ohio, and Chicago, Ill. The clearance on some westbound lines was not sufficient, so that the cars were moved at scheduled times against traffic on eastbound lines. One tunnel had sufficient width but was not high enough to clear the 17 ft height. Therefore, the boiler was turned on its side. Another tunnel could not be cleared either way. The boiler was consequently unloaded, trucked around the tunnel and reloaded. Despite all these difficulties, the boilers arrived in Torrance one month after leaving New Jersey.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

☆

ROUND AND ROUND SHE GOES—AND HOW!

The wheel of fortune spins, so Major Bowes tells us, but the wheel of fortune has nothing on a new little gadget the boys in the motor division of the General Electric Co. recently whipped into shape. This is a little electric motor which runs at the incredible speed of 120,000 rpm! No, you don't have to read that over, it actually says 120,000 rpm—2000 revolutions per SECOND! This is more than seven million revolutions per hour.

It's not a very large affair but it is a little giant when it comes to output. It is rated, 3 hp and weighs but 7 lb, as contrasted with the standard 3-hp, 1800 rpm motor which weighs 105 lb. In size, it is so small that it fits into the palm of a person's hand, while the rotor is scarcely larger than a man's thumb. With normal voltage applied at 2000 cycles, the new motor reaches full speed in less than a second.

The motor was developed for application in internal grinding machines used to finish small holes, many less than 1/4-in., in diam. The surface speed required to produce high-grade finish economically should be approximately the same whether grinding a large or a small hole. A medium size wheel rotating at moderate speed gives the requisite surface speed but for small holes only a tiny grinding wheel can be used, hence the high rotating speed is essential.

Tests the motor has passed successfully at 120,000 rpm, include 8-hr continuous runs at rated horsepower as well as grinding tests with a tiny grinding wheel mounted directly on the motor shaft. Another possible use for the motor may be in drilling tiny holes, 1/32 in. or less, in soft metals.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Men of Mechanical Might

Engineers! What are ye? Are ye mice, or are ye men? Whatever ye are, here is an article which, though it may not say so in so many words, seems to imply that ye are mice. Mr. Knapp, the author of this article has been a subscription salesman for POWER PLANT ENGINEERING for over 25 years. By virtue of his contacts with power engineers in this work he has come to know them very well and is, therefore in a position to speak about their problems quite frankly. What do you think of Mr. Knapp's criticism?

By HERMAN A. KNAPP

In over 25 yr of intimate contact with power engineers of all varieties and in all types and sizes of plants, I feel that I know quite a lot about these men and therefore am qualified to speak somewhat critically about some of their problems. If you happen to be one of them, you may be inclined to get a little sore in spots because of what I am going to say here but if you will read to the end it should become apparent that I am the engineer's best friend and that I am only trying to help him.

Let us be frank from the very outset. The title I have chosen may appear to be complimentary, but don't fool yourself about this because the implication is that power engineers are men of mechanical might *only;* they are not so mighty when it comes to getting up courage to demand better return for the value of their services.

Before I wrote this, I talked the matter over with some power engineers of the average type. Several endeavored to dissuade me from writing because, in time of war they felt we should try to keep all hands contented regardless of their status or condition. I suspect that some of these boys are only dodging an issue. Actually, the low wage scale of such vital workers is creating a high labor turnover which in turn is slowing production and probably prolonging the war.

Having visited the homes of thousands of power engineers, I firmly maintain that they do not live as well as men of their position and importance should. This is not the fault of their wives, either, because they constitute a group of our most worthy American women. It is simply because their men do not bring in enough money.

Where the welfare of women and children is concerned, I'll go the limit, even in time of war. Besides, when the war is over there may be some other excuse, such as bending our entire effort toward establishing permanent world peace. So let's thrash the matter out right now rather than wait, perhaps for many years.

First, we should make some distinction between the practical and technical power engineers which is difficult because there is always a certain percentage who overlap in both directions. The technical man isn't so well paid either. He may appear to live better, but investigation reveals a variety of long-term obligations which keep him close to the ragged-edge.

The Power Engineer's True Worth

Let us concede that the farmer, supplying the prime necessities of life, is our most essential person and that the builder, providing us with shelter, comes about second. But the power engineer, giving us practically all of the energy utilized in fashioning raw products as well as furnishing most of the comfort conditions in housed properties, must be considered the top man in organized industry and advanced routine of living. This fact, I think, is too obvious to require further proof. Unless you live a primitive form of life, just convince yourself by trying to do without any of the benefits supplied by power plants for as little as half a day.

With this fact in mind, I am going to compare the true value of various classes of power engineers with that of their better-paid contemporaries in other fields of endeavor. All comparisons are made *strictly without prejudice* in the interest of obtaining a true picture of the situation.

Power engineers can quite easily be grouped into three classifications depending upon the type of plant they operate, namely utilities, industrials and service properties. These divisions are quite definite except for an occasional case of overlap.

Utilities

In the utilities the power engineers belong to that essential group of employees who construct, operate and maintain utility systems. Though paid living wages or better, they cannot reap their deserved share as long as certain internal and external conditions prevail.

In the case of public-owned utilities, the earning possibilities are limited because of the smaller size of such systems. Political factors also frequently cut in on their net earnings and in the nature of things employees of public-owned utilities might as well be content with modest recompense.

The bulk of our utility engineers, however, work for privately-owned companies. Although, generally, very fair to their essential employees, these corporations quite naturally show no more inclination to overpay them than does any other large corporation.

If the essential employees in the utilities had seen fit to organize in the early days, they would undoubtedly share in a larger proportion of the profits today. At one time, in the period of unrestricted so-called free enterprise there was plenty of money available in the industry and if the engineers and operators had taken better care of their own interests, they might have obtained more of it for themselves. Now, however, with the utilities under strict government supervision, there is far less chance for the engineers to advance their status.

Industrials

The power industry is the common denominator of all industries—it is a part of all of them, hence, is bigger than any single one of them. Despite the fact that many industrial plants buy electricity and even steam from the utilities, there are many thousands of plants producing both steam and electricity and these, on the basis of investment and output far exceed the investment and output of any other single industry.

In many industries, the power engineers have supervision not only over the power plant but over much of the production equipment in the factory itself. They often have charge of the maintenance and upkeep of such equipment and in addition are responsible for fire protection. In many cases, the power engineer is the most sought after man in the plant and he is constantly on call by all departments. His hours are long and frequently he has to spend nights and Sunday repairing equipment that has broken down.

Despite all this, the average power engineer is not paid as well as the average production man, much of whose work is constant repetition. The stronger labor union affiliations of this group have much to do with this.

This inequality in remuneration is not so great in industrial plants where the power engineer is working with other mechanical men who realize the importance and complexity of the engineer's work. Often, they would honestly like to pay him more in keeping with his true value, but they lack the authority or money to do it.

In most cases, however, the power plant and the men associated are looked upon as a necessary evil—something that cannot be done without but not to be taken seriously when it comes to mak-

ing up the payroll. Here, the man who does an accurate job, as testified to by numerous recording instruments, takes a back seat in favor of those who cannot offer tangible proof of their worth to the community.

The Service Field

The service field is that tremendously large one where power and heat is used for the comfort and convenience of human occupants rather than manufacturing processes. It includes office buildings, hospitals, hotels, schools, public buildings, theatres, etc. This group present such a variety of inconsistencies that I am going to present some actual illustrations.

First, we have a large public school. Charlie R. is the chief engineer. His boiler room performance is indicated by steam gages, flowmeters and CO_2 recorders; his engine room performance by ammeters, voltmeters, pressure gages and indicator diagrams; his room temperatures by thermometers and spinstrometers (old maid teachers constantly cold). His coal, oil and water consumption are accurately checked and recorded.

Eustace P. is the principal. They all say he does a fairly good job, but what instruments are used to record his performance? Besides, compulsory education places him in a commanding position, like it or not.

There is a Miss S. who teaches ancient history. Apparently she does it quite conscientiously, too. But what indication do we have that her work is all it should be?

Miss T. teaches social problems and is considered quite competent. But this is such an elastic subject that one hardly knows where to start and stop. Complicated by such controversial factors as race, religion, wealth, sex, social standing and the like, its teaching can hardly be expected to conform to well-defined precedents and her teaching might do more harm than good, but by what standards is she to be judged?

Mr. B. teaches mathematics. Here is a subject highly desirable because essential and capable of withstanding a check-up which is one hundred per cent accurate. The only variable element rests in his ability to impart his knowledge to his pupils, plus their own degree of receptivity. A good mathematician may not necessarily be a good teacher.

The same applies to teachers of sciences which can be calculated in mathematical terms. This group makes up the most indispensable, as well as desirable, members of the school's faculty and their value approaches that of the power engineer. The others, including even the principal, must be rather farther down the list because the results of their efforts are so difficult to gage. Yet the engineer is paid 40 per cent less than the teachers collectively.

But we mustn't forget I. D. Zine of Powers and Hiedt, the architects. He drew up the plans which gave the school such an efficient layout, but still makes $1500 a year less than its principal.

Case No. 2 is a large public building. Michael O., the chief engineer, has a plant and recording instruments similar to those of the school. In addition to that, he has an air conditioning plant which is likewise highly instrumented.

Judge S., sitting in a court room up above, has just sentenced an offender to three years in the reformatory. Just what relationship exists between his felony, that of burglarizing a home occupied by a couple of old ladies, and the arbitrarily-chosen period of three years? Punitively there is no explainable one; while correctively, there is no convincing reason to figure he will reform in three years; he may do so instantly or it may never occur and three years is certainly no mean between such extremes.

Judge R., reposing in his chambers on the fourth floor, has just signed a recommendation for parole, though he does not have *accurate* indications of such change in the prisoner as might warrant it. Said parole will require periodic check-up by a parole officer. Said parole officer, though a man of high character who has read up a little on criminology, does not have the faculty of fully understanding the actual workings of a criminal mind. Only a reformed criminal could be relied upon to do such a job with consistent efficiency.

In another part of the building, a board of assessors sits to evaluate properties. They are assigning such figures as they think the properties should be worth. When actual sales occur at figures ranging from 40 to 200 per cent of assessed values, then we get some idea of how ridiculous some of their work has been.

There is also a meeting of an election board to certify certain candidates elect for seating in a legislature. Candidate A got every single vote in his district; Candidate B carried his by only one vote; but in legislature their votes will both count the same. We will not take the time to go into the legislature itself to point out some of the useless and unenforceable laws they pass.

So, at the end of any day, the building engineer is the only man at hand who has done a job whose accuracy and usefulness can be established by undisputable records. Yet he makes less than half as much as the other fellows.

Now we come to Case No. 3, an office building—In a law-office suite we find even more marked contrasts too numerous to mention. Here are people who are very accurate in the wording of their documents, but we must admit that the result of their litigation is often anything *but*. Other suites reveal similar contrasts too numerous to mention.

Case No. 4—a hospital—Here we

"Oh, that's okay, we all look alike in overalls—it's straight ahead and the second door to your left."

finally find a man who probably surpasses the engineers for the exactness of his work, though it also lacks recording instruments. It is a surgeon performing a skillful operation. Other departments of many hospitals, however, are not operated quite so precisely.

In this way we could go down the line and compare if we had the time. In practically all cases the engineer would come out on top on the basis of proven useful work—and near the bottom on the basis of the plant's payroll.

What Has the Power Engineer Done About It?

Frankly, he has done very little except complain. And what he has done hasn't had the punch to beget good results.

Andrew W. Kramer, managing editor of POWER PLANT ENGINEERING, recently published an article bemoaning the fact that million dollar plants hire $1500 men. He contends, quite logically, that the owners of these plants suffer in dollars and cents through such false economy. If this idea can be put across, it should work wonders.

Unfortunately, however, the power engineers lack the organization to further such a thought, and such organizations as they have formed are badly split up into small groups.

Labor unions could do the trick if they had more unity. In some of our large cities power engineers belong to as many as a dozen different unions, some of the trade and others of the industrial variety. We must admit, also, that there is considerable friction between them.

Engineering associations of the non-labor kinds could do much toward the remunerative end if they had more membership. The largest national organization of the present has less than 20,000 members or about two per cent of its potential membership.

So the setup looks pretty bad. Is it hopeless? Of course not!

How Can It Be Done?

Only by a complete showdown, which means exposing the other fellow in his true light. This shouldn't be difficult if the power engineers produce their records and insist that those better recompensed produce theirs. But even then it will require an abundance of ingenuity and courage.

These records, the accurate ones supported by technical data, will naturally show up highly in favor of the power engineer and to the disadvantage of his bluffing opponent. But don't make use of this circumstance by pouncing upon him right off the bat. Remember, he still has the balance of power—and enough money to make you miserable.

It may be good policy to soften him up, first, by ridicule: just have a good laugh, at his expense, because of the established laughability of his alleged accomplishments. This is a most disarming weapon and gets so contagious, sometimes, that the rank and file of the people begin laughing with you. Then your battle is almost won.

Ridicule, alone, may cause some of the power engineer's better paid, though less worthy, competitors to quit in shame. But the majority will still hang on because of the easy money they are making.

So if the power engineer wants to attain the recognition he justly deserves after years of privation, he must enter the political field and form his own party. This party will be constructed according to his own principles and based upon his own ideas. Hence, it should function to the utmost benefit of the largest number of people, because formulated by a body of our most useful citizens who have had contact with practically every form of human activity.

The manner in which these ends can be achieved would have to be worked out and they might not be easy and if ever the power engineer expects to get anywhere he will have to start some time. If he does not look after his own interests, it is safe to say that no one will and he will have nobody to blame but himself.

Suitability of Different Kinds of Fire Extinguishers

EFFECTIVE "first aid" fire fighting requires the use of a suitable extinguisher on each different class of fire. There are three classes of fire, each determined by what is burning; and for each class there are appropriate extinguishers.

Fires in ordinary combustible materials, such as wood, paper, textiles, rubbish, etc., are known as *Class A* fires. They are best put out with water, which has a cooling and quenching effect. Extinguishers which contain water or chemicals and water are the soda-acid, foam, pump tank, gas cartridge and loaded stream types.

Vaporizing liquid and carbon dioxide extinguishers also are effective for controlling small Class A fires, if the fires are not deep-seated and if there are no strong air currents to dissipate the vapor or gas.

Fires in flammable liquids, grease, etc., are known as *Class B* fires. Here a blanketing effect is essential, to cut off the oxygen supply. Suitable extinguishers are foam, vaporizing liquid, carbon dioxide, and loaded stream.

Fires in electrical equipment, *Class C* fires, require the use of extinguishants that will neither damage equipment nor convey an electrical charge along the hose stream to the operator. Vaporizing liquid and carbon dioxide extinguishers are suitable for use on fires of this class. However, in some cases, fires in electrical equipment may be such that the quenching and cooling effect of large quantities of water is necessary. In such cases, the equipment should be made electrically dead before water or water solution is applied.

The Underwriters' Laboratories label on every approved fire extinguisher indicates the class or classes of fire for which that extinguisher is considered suitable and the number of such extinguishers considered necessary to comprise one unit of protection. Thus, a 2½-gal foam extinguisher is designated "A-1; B-1," meaning that it is approved for use on both Class A and Class B fires, and that one such extinguisher is required to make one unit of protection. These units of protection are standards that have been established by Underwriters' Laboratories for convenience in measuring the relative fire protection afforded by different kinds and sizes of portable fire extinguishing appliances.

The number of units of protection required in any given location depends upon the relative severity of the incipient fire to be anticipated. The National Fire Protection Association recognizes three general classes of occupancies—light hazard, ordinary combustible and extra hazardous. A guide for determining the number of units of protection required for each class of occupancy has been worked out. For instance, units should be so located that a person will not have to travel more than 50 ft to reach the nearest unit.

The inspection department having jurisdiction usually will determine the degree of hazards of a given occupancy. Further information is contained in a pamphlet entitled "First Aid Fire Appliances," published by the National Board of Fire Underwriters, 85 John Street, New York, New York.

Safety Precautions

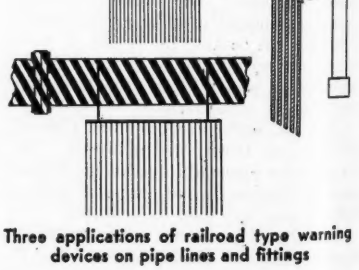
By Thomas Trail

OFTEN, in power plants and buildings, there are valve wheels, pipe fittings, etc., that are so situated that workmen strike their heads on them in getting about among the equipment.

To guard against this hazard, it is suggested that some form of warning device be employed such as are usually placed before tunnel openings on railroads to warn brakemen on top of railroad cars that the train is about to enter the tunnel. Such a device could consist of several strands of cord, rope or leather suspended near or on the obstruction. In some instances it might be necessary to place it in front of the obstruction to prevent a workman from striking his face against it, especially in dark locations.

Painting such obstructions white or some other bright color or contrasting striped colors might provide an additional warning. However, the colors should be selected so as not to conflict with the color code of valves and piping in the plant, if such a code is in use.

The accompanying sketches give some ideas for such warning devices.



Three applications of railroad type warning devices on pipe lines and fittings

The Mollier Chart

The Mollier Chart, what it is, how it is constructed and what it is used for. A short, practical discussion with examples showing exactly how problems in steam engineering are solved by means of this chart

By DENARD L. GUSLER

THE MOLLIER CHART (Fig. 1) is a convenient device for determining the approximate heat content (Enthalpy) per pound of steam in any condition of superheat, saturation, or wetness. Changes which occur at constant entropy, constant pressure, constant quality, constant superheat, or constant temperature, may be readily traced on this type of heat chart. The chart shown in Fig. 1 is only a skeletonized form of the actual chart which is available in any good book of steam tables.

The chart is divided into two sections by a curved line, called the Saturation Line. This line represents steam in a dry saturated condition. Points on any curves above the Saturation Line represent superheated steam and points below this line represent saturated steam. Below the Saturation Line and nearly parallel to it, are lines of Constant Moisture, Per Cent, which refer to the quality or degree of wetness of the steam. Nearly parallel to, and above the Saturation Line are lines of Constant Superheat, Degrees Fahrenheit, which represent the number of degrees to which the steam is superheated. The lines designated as Constant Temperature, Degrees Fahrenheit, represent the actual temperature of the superheated steam. Lines of Constant Pressure, Psi Absolute, intersect the afore-mentioned curves so that conditions of the steam at a given pressure, with reference to superheat, temperature, degree of wetness, etc., can be quickly determined.

There are two scales at the edges of this heat chart. The one at the right hand edge, repeated at the left edge for convenience, is the scale of British thermal units, and is used to determine the heat content (Enthalpy) per pound of steam, in any state represented by a point on the chart.

The second scale, at the top and bottom edges of the chart, is the Entropy scale and is used to determine the Entropy of steam in any state.

A method of constructing the Mollier Chart is shown by the diagram, Fig. 2, but before attempting an explanation of this construction, it is necessary to give some consideration to Entropy, what it is and how it can be used.

Entropy, for the purposes of a practical treatise such as this, may be defined as an artificial property of a fluid used as a device convenient to the designers of machines wherein expansion or compression of gases and vapors are involved.

The Steam Tables give a zero value of Entropy of water at 32 F and it increases in value as the heat of the liquid is increased until the critical point, 3206.2 psi abs, is reached; here the Entropy of the liquid and steam is the same, 1.0580. Then the Entropy value increases as the steam pressure is decreased as dry saturated steam until at 32 F the Entropy of the vapor is 2.1877.

It thus becomes increasingly evident that we are not so much concerned with absolute values of Entropy, as we are with the changes of Entropy that occur under varying conditions.

Now, to see how this works in actual practice, suppose that steam at 240 psi abs and 500 F is allowed to expand through a theoretically perfect turbine to an exhaust pressure of 18 psi abs.

In the theoretically perfect turbine no heat is lost through blade friction, radiation, or in any manner except that which is converted into work. This is called adiabatic expansion. Due to the fact that the turbine is perfect the expansion will take place at constant Entropy, which makes the expansion, reversible adiabatic, or isentropic (Equal Entropy), called reversible because the expanded steam can be compressed exactly the reverse of the manner in which it expanded.

The following data is obtained from the Steam Tables:

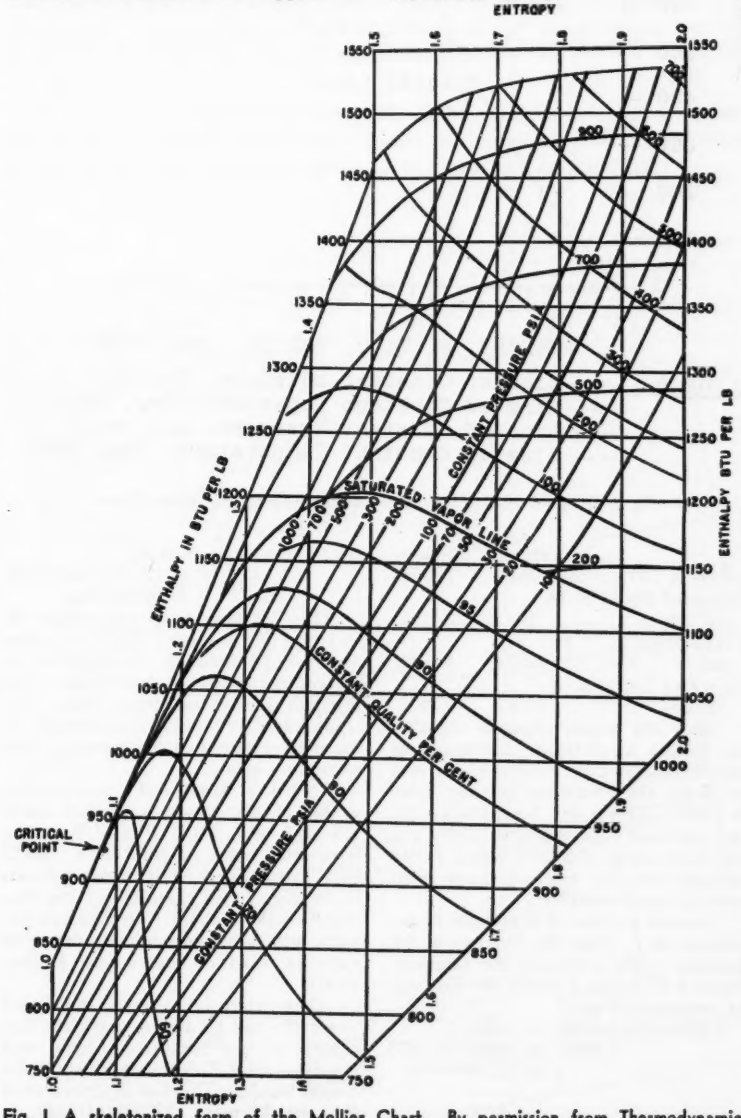


Fig. 1. A skeletonized form of the Mollier Chart. By permission from Thermodynamic Properties of Steam by Keenan and Keyes. Published by John Wiley & Sons, Inc. This diagram is presented only to show the general structure of the chart. For accurate work, an actual Mollier Chart as presented in engineering handbooks should be referred to

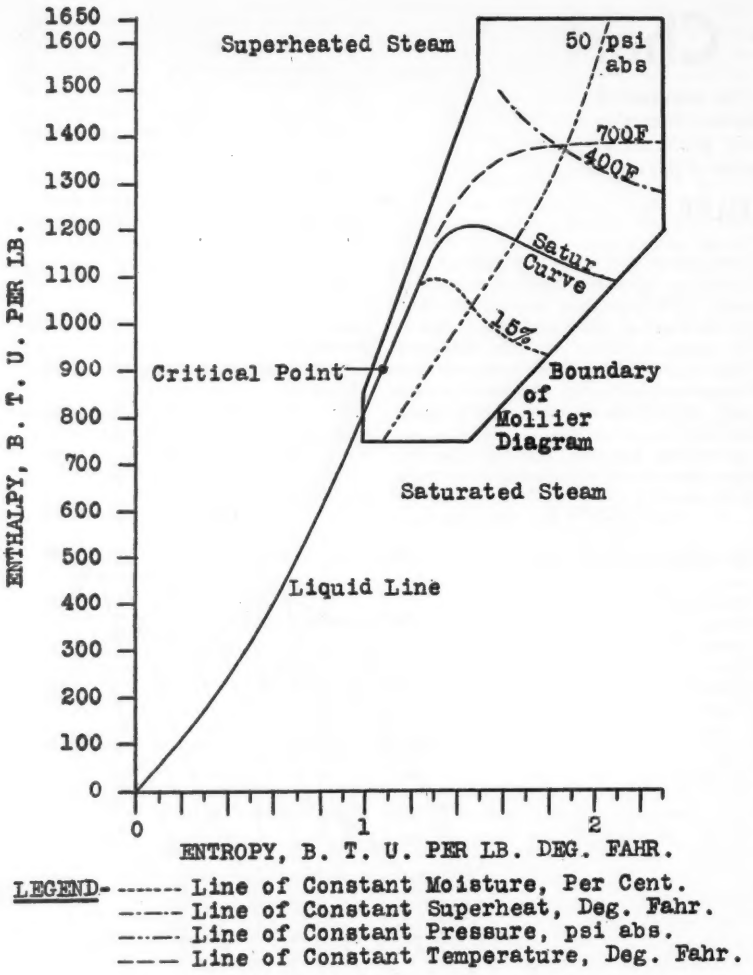

Superheated Steam
50 psi abs
700F
400F
Satur Curve
15%
Critical Point
Boundary of Mollier Diagram
Saturated Steam
Liquid Line
ENTHALPY, B. T. U. PER LB.
ENTROPY, B. T. U. PER LB. DEG. FAHR.
LEGEND- ------ Line of Constant Moisture, Per Cent.
-·-·- Line of Constant Superheat, Deg. Fahr.
-··-·- Line of Constant Pressure, psi abs.
— — — Line of Constant Temperature, Deg. Fahr.

Fig. 2. Diagram showing the method of constructing the Mollier Chart

	Enthalpy	Entropy
Steam at 240 psi abs.	1264.5	1.6003
Saturated liquid at 18 psi abs	190.56	0.3275
Evaporation at 18 psi abs	963.6	1.4128
Saturated Vapor at 18 psi abs	1154.2	1.7403

Since the steam expands through the turbine at constant Entropy, it is necessary to find the condition of steam at 18 psi abs where its Entropy value is 1.6003. This value lies between the dry saturated vapor value of 1.7403 and the liquid value of 0.3275, which would indicate that the exhaust steam must contain some moisture.

Assume a value of dry steam in the exhaust of y. Then the Entropy of the exhaust steam is that of the saturated liquid 0.3275 plus y times the Entropy of evaporation or;

$$0.3275 \text{ plus } 1.4218y = 1.6003$$
$$1.4218y = 1.6003 - 0.3275$$
$$y = 1.2728 = 0.90$$
$$1.4218$$

This means that the exhaust steam is 90 per cent dry or 10 per cent wet. The Enthalpy of the exhaust steam is:

190.56 plus (963.6 × 0.90)
= 190.56 plus 867.24
= 1057.8 Btu

This is the same percentage of moisture and the same Enthalpy value that will be found if the problem is worked out on the Mollier Chart. The problem illustrates clearly how Entropy can be used advantageously in the determination of the quality of the expanding steam.

To better visualize the construction of the Mollier Chart, a vertical scale, ENTHALPY, BTU PER LB, and a horizontal scale, ENTROPY, BTU PER LB DEG FAHR, can be drawn as in Fig. 2. So that 500 on the Enthalpy scale is about 1 on the Entropy scale, which is approximately the same ratio as used on the actual Mollier Chart.

Then, starting at zero, the liquid line curve can be drawn, using the Enthalpy of the Saturated Liquid and corresponding Entropy as given in the Steam Tables. This line is drawn until the critical point, 3206.2 psi abs, is reached. The Saturation Curve is now drawn, using the Enthalpy-Entropy values for Saturated Vapor.

The Pressure Line for steam at 50 psi abs crosses the Saturation Curve at a point where the Enthalpy and Entropy is the same as that in the Steam Tables for 50-lb Steam. Below the Saturation Curve the Pressure Line is a straight line, drawn at a tangent to the liquid line curve. Above the Saturation Curve the pressure line bends slightly due to difference in the rate of Entropy change.

The curves for Constant Temperature and Constant Superheat can be plotted using the Enthalpy-Entropy values from the Steam Tables in the manner already indicated. The Constant Moisture curve values can be calculated as shown in the problem using reversible adiabatic expansion.

It will be seen in Fig. 2, that the Mollier Chart includes only the Superheat and higher qualities of the Saturate region of steam, with Entropy change from 1 to 2.3 and Enthalpy change from 750 Btu to 1638 Btu. At that it is a good size diagram and must be spread out on a large surface to be used satisfactorily.

Following are several examples that will show how the chart Fig. 1, can be used:

EXAMPLE I—Find the Enthalpy and Entropy of a pound of steam at 400 psi abs and 640 F.

The point of intersection, representing this state of steam, lies where the 400-lb pressure line crosses the 640 F Temp. line. Reading horizontally across, the Enthalpy is 1330 Btu. Reading vertically downward, the Entropy is 1.6105.

EXAMPLE II—Find the engine efficiency of a steam engine using steam at 150 psi abs and 600 F, exhausting at 1 psi abs. The water rate per indicated horsepower is 15. The formula to be used is

$$EE = \frac{2545}{15(H1 - H2)}$$

Reading horizontally across from the point of intersection of the 150 psi abs line and the 600 F line, the Enthalpy is 1325.7 Btu per lb of steam. Reading from this point vertically downward along a line of constant Entropy until the 1-lb line is intersected, and then horizontally across, the exhaust Enthalpy is found to be 956 Btu per lb of steam.

$$EE = \frac{2545}{15(1325.7 - 956)} = 45.9 \text{ per cent.}$$

EXAMPLE III—Find the heat change, per pound of steam, when steam at 200 psi abs is allowed to expand through a reducing valve against a back pressure of 20 psi abs. NOTE: For straight throttling the rule is that the Enthalpy during the expansion remains the same.

From the point of intersection of the 200-lb line and the saturation curve, the Enthalpy is found to be 1198.4 Btu. From this point an imaginary horizontal line may be drawn until the 20-lb line is intersected. It will be noted that this point lies in the superheat region of the chart. Reading from the temperature curves the original steam

temperature has decreased from 381.79 F to 314 F approximately. The difference, 67.79 F, superheats the steam as it passes through the reducing valve.

This example indicates the possibility that, since the Enthalpy remains the same during expansion through a reducing valve, there is no loss. But such is not the case. There is a decrease in the efficiency of the steam due to the increase in Entropy.

The usual processes for a vapor are those which take place at constant Entropy and those which take place at constant Enthalpy. Therefore, Examples II and III show the most common uses of the Heat Chart.

The Mollier Heat Chart, where extreme accuracy is not absolutely essential, has many useful applications. Particularly in applying practical formulas to the calculation of heat changes that occur in the usual steam-operated mechanisms in a Power Plant.

How to Operate Extinguishers

THE SPEED WITH which an employee uses an extinguisher to attack an incipient fire often makes the difference between an incident and a disaster. Therefore fire protection authorities recommend that periodic fire extinguisher demonstrations be held to teach plant personnel the simple but important rules for operating extinguishers. If demonstrations are too difficult to arrange, this information can be conveyed by means of wall posters, articles in company papers or oral instructions by foremen.

Below are step-by-step directions for operating the different kinds of approved hand extinguishers:

SODA-ACID and FOAM extinguishers are usually hung on wall hangers or set on brackets or shelves. Take the hose between the thumb and index finger of the right hand and grasp the ring-top handle. Then with the left hand lift the extinguisher off the hook and lower it, keeping the extinguisher in an upright position. Carry the extinguisher to the fire by means of the ring top handle held in the right hand, still maintaining a hold on the hose nozzle.

To set the extinguisher in operation, grasp the bottom handle with the left hand and turn the extinguisher upside down. Release the ring top handle, but continue holding the hose in the right hand to direct the stream.

GAS CARTRIDGE and LOADED STREAM extinguishers closely resemble soda-acid and foam types and are operated in much the same way. When these types are inverted, they must be bumped on the ground to rupture the carbon dioxide cartridge that supplies the pressure to expel the stream.

VAPORIZING LIQUID extinguishers of the pump-gun type generally are suspended in wall brackets. Remove the extinguisher by grasping the handle in the right hand and pulling outward. Hold the nozzle end in the left hand with the index and middle finger straddling the nozzle tip. On the way to the fire, twist the handle to unlock it and, if the device is of the air pump type, move the index finger over the nozzle tip and pump up pressure. To expel the stream, move the index finger back and pump steadily and vigorously with the right hand.

Larger sizes—1, 2 and 3-gal capacity —are sometimes provided for special use. They are carried to the fire by the handle at the top and operated by hand pump or by stored pressure. To operate the pump type, rest it on the floor, and pump with the left hand while aiming the hose stream with the right. The stored pressure type is operated by opening the valve provided on the head castings, while the right hand holds the hose nozzle.

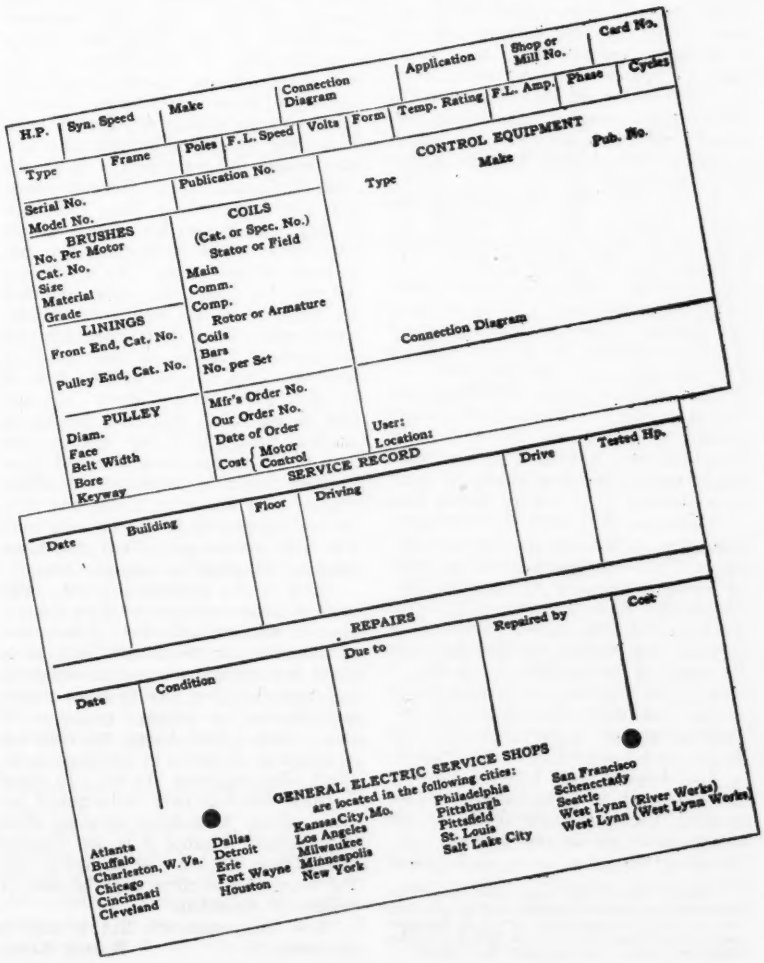
CARBON DIOXIDE extinguishers are carried to the fire with the left hand, by the handle provided for the purpose. To operate, rest the extinguisher on the ground, pull the locking pin out, take the horn-like nozzle in the right hand, and turn the valve counter-clockwise with the left to release the gas.

PUMP TANK extinguishers are carried to the fire by means of the top handle. The pump is operated by the left hand, while the right hand aims the hose stream.

Motor Record Card

AVAILABLE from the General Electric Company, Schenectady, New York, to all maintenance engineers, is a motor record card (GES-1526A) of convenient size (4 by 6 in.) for card files and containing spaces on both sides for the recording of essential information on each motor as well as the nature and extent of inspections and repairs.

With the use of this card for each motor in the plant, the maintenance engineer has the motor's history right at hand. In this way, excessive amounts of attention or expense will show up and the causes can be determined and corrected.



LETTERS AND COMMENTS

He Does Not Believe It Could Work

I CANNOT get my mind off the home-made water level control which appeared on page 108 of the December issue under "Practical Hints and Kinks" which the author claims to have discovered in a cotton gin somewhere in the south. The author did not say whether or not he saw the gadget actually controlling the water level. I cannot understand how such a hook-up could be successful not to mention a one-inch water level variation. Of course it may be one of those cases where the engineer says it could not work but someone comes along who doesn't know it won't work and makes it work in spite of all the theories against it.

In the first place the stuffing box which carries the float rod through the boiler shell would be either too loosely packed to permit free action of the float or too tightly packed to prevent steam leakage and the float sticking in most any position. To keep it steam tight there would of necessity be a great deal of friction.

In the second place the stuffing box and sliding stem on the feed valve would present the same difficulty—that is, it would be either leaking or sticking since the power of the float would be spent in overcoming friction in the stuffing box.

There are float controlled feedwater regulators made today but the manufacturers eliminate stuffing boxes as much as possible—especially sliding stem stuffing boxes. Now, if the inventor of this machine had had a float operating a rotating stem through a stuffing box then it would be more likely to work. I wouldn't be surprised if the water tender in this plant didn't do a lot of his controlling through a hand valve in case he got tired changing the adjusting nuts.

Last but not least I would say that the old timer was the gadget and the modern feedwater controllers on the market today are the real things.

Rittman, Ohio — U. J. GRANT

Editor's Note: We quite agree with Mr. Grant in his comments on this system. Nothing was said about the pressure carried in the boiler but with anything over 5 lb it is difficult to understand how such an arrangement could work.

Million Dollar Plants vs. $1500 Men

YOUR ARTICLE about million dollar plants and $1500 men is much to the point. My boss sure ought to read that article but I know what he would say—"The guy is just a rabble rouser." If you think I am kidding, here is the wage scale at this plant. Shift operators, $1.05 per hr, firemen, 75 cents, coal passers, 64 cents. The chief engineer gets $65.00 per week. He often comes in on Sundays—he is expected to—and works free, gratis. Labor turnover is rapid and often the firemen have to double up on shifts for lack of help. They are all money hungry and are glad to get the overtime but it doesn't make for good work. None of these men are interested in their jobs, nor if they were could they expect to get much advancement. Sometimes they last as much as two weeks. As a rule the engineers do their own oiling and they are supposed to do their own maintenance work. They do it when they are so disposed. Some of the operators work six days a week and do from 6 to 10 hr extra on a Victory shift and then on top of all that do a Sunday at another plant. It is my opinion that such men have too many jobs and some of them should be eliminated. Also the firemen who fire 8 hr a day and then do coal passers' work for an additional 4 to 6 hr at time and a half cost more than a coal passer at straight time.

Most of the equipment is old. The place is always upset, parts lying around, covered with coal and dirt. Every once in a while something vital such as a pump or a feedwater heater breaks down and then the gang has to work nights and Sundays or holidays to get it in shape again. Such things are regarded as a matter of course by the brass hats; that's what engineers are for. In many instances the fires have to be pulled because of the breakdown of some piece of equipment because it is not installed in duplicate. In one case we had to pull the fires twice in three days because of failure of equipment.

Boy, this engineer's life is sure a gay one. — ROBERT BAKER

Effect of Piston Area on Point of Cut-off

I HAVE BEEN ADMIRING the indicator cards appearing in POWER PLANT ENGINEERING in the December issue and have wondered if they had any load on when taken. The cut-off on both the head and crank end is the same. My experience has been on heavily loaded Corliss engines that the cut-off on the crank end should be a little late, allowing a little more steam to compensate for the piston area taken up by the rod.

I had one Corliss that the manufacturer couldn't smooth out until he allowed more steam at the crank end of the stroke.

Racine, Wis. — CLARENCE A. GIBBS

Furniture Plants Bad as Gusler Says They Are

IN THE January, 1944, issue of POWER PLANT ENGINEERING I am indeed interested in your Who's Who of the "Practical Engineers' Section." It is a pleasure to read your presentation of Mr. Denard Lee Gusler and I believe that this young man has a splendid future assured him.

I have read with considerable interest his article in the December issue, as well as the present article on "Post War Power Plant for Furniture Factories."

During the years 1931 to 1936 the writer visited well over 100 furniture manufacturing plants in the south and eastern section of the United States. These visits placed me in close contact with the steam generating and distribution plants of many furniture factories as a part of my regular job at that time.

With a very few exceptions the power plants compared to the description and some even worse, as outlined in Mr. Gusler's article. I, for one, agree that there is a real post war opportunity for many modern improvements to be made in furniture manufacturing plants, steam generation, and power distribution stations and it seems to me that this field of improvement offers to Mr. Gusler a splendid engineering opportunity for the immediate future and his foundation is sound.

The benefits and profits to be ultimately derived by the management of the furniture companies from this one division of the business is by no means limited to a small margin and it can certainly be taken out of the category of a necessary evil of caring for the business and be placed rightly, as it should be, as one of the best and most efficiently operated divisions of the entire company.

Mr. Gusler's article in dealing with "What Should Be Done" and the various supporting data and figures contained in his article presents in a brief and concise manner serious food for thought on the part of the management in charge of wood working plants anywhere.

Youngstown 1, Ohio — P. R. DUFFEY
Special Engineer,
The Youngstown Sheet & Tube Co.

Million Dollar Plants vs. $1500 Men

THE COMMENTS made in your article Million Dollar Plants vs $1500 Men certainly hit the nail on the head. I have worked in two very modern power houses, each representing not one but several million dollars' investment, and yet in spite of the huge initial outlay, almost nothing was or is being spent directly to train operators.

The usual procedure is to bring a new man into the power house and put him with an old operator who then teaches the new man his way of getting things done, "because that was the way it was showed to him." True, in both these cases the company has excellent engineering staffs and from a technical standpoint the power houses are well managed but talk to some operators with years of experience and they don't know the definition of a Btu.

In situations such as mentioned, if the operator does wish to learn he must pursue a course of home study such as I. C. S. or Columbia extension. Then after acquiring a reasonable smattering of technical knowledge the operator wants to move on to a better position but in all except the very broad-minded companies he finds he is bucking degree-men and management cliques. Here is a striking contrast of two companies I know about:

Plant No. 1—
- Mechanical Super—BS Degree
- Power Plant Super—MA Degree
- Assist PP Super—BS Degree
- 4 Shift Supervisors—3 BS degrees and 1 practical man

Plant No. 2—
- Plant Master Mechanic — practical man
- Power Plant Super—practical man
- Assist PP Super—practical man
- Shift Supervisors—practical men

Both are industrial power houses and if a close check were made I sincerely believe the No. 2 plant is run more efficiently than the No. 1 plant, simply because these men accumulated their technical knowledge as they learned operation and the result was better all-around qualified operating engineers. I don't mean to belittle the college man because I admire the tremendous effort that culminates in the successful completion of a course in engineering. But Management should, in most cases, take more interest in the education of the operating personnel if it wishes to develop maximum results.

I mentioned all this because it is so much in line with what you had to say in your article and I hope you will keep punching in that direction.

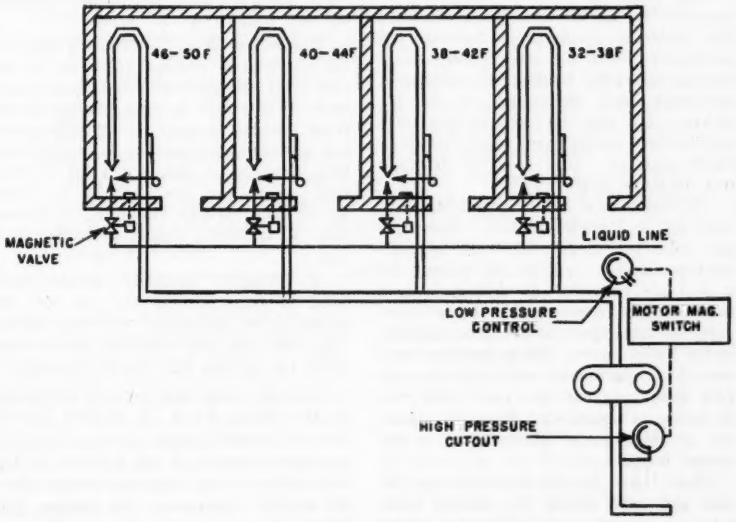
Morgantown, W. Va. DENARD L. GUSLER

More Refrigeration System Design

GEORGE HOLMAN should be writing textbooks on refrigeration, for he knows his stuff and has a real knack of explaining things. His problem of making adjustments to a number of ammonia thermoexpansion valves, (pages 86-89, P. P. E. Nov. 1943) is in line with a somewhat similar refrigeration system—also with certain blankety-blank features —which I worked over prior to Pearl Harbor. (Do you still remember those times, when you could buy new equipment of every description?)

There were four cold storage rooms, equipped with a single thermoexpansion valve, which ran wide open all the time. The remote bulb was in the third room, the valve being in the first room. The frost possibly got back to the third room each Sunday night—never to the fourth. But when the store was open for business if one of the rooms was the desired temperature the others were sure to be too hot or too cold.

I had the opportunity to do some redesigning as I overhauled the conglomeration, with the results shown in the accompanying diagram. Each room was equipped with a 1-2 ton thermoexpansion valve, a line voltage thermostat with an approximate differential of 2½ F and a magnetic ammonia liquid stop valve in the one-half inch liquid branch line. Instead of having the thermostats in parallel to control the starting and stopping of the compressor, I wired them in



Cold storage rooms with a thermoexpansion valve and magnetic ammonia stop valve in each room

separately, each one to control the opening and closing of the liquid valve for that particular room.

A low pressure ammonia control was installed in the suction line near the compressor. This control and the usual high pressure cutout were both wired to the motor starting switch. The low pressure control would operate with a differential of only 6 lb, however I set it for a little more than that, in order to keep the compressor from starting and stopping too often.

This differential of about 10 lb made it easier to adjust the thermo valves than would a differential of 40-odd, such as Mr. Holman mentioned in his article. The control is set, say, to cut in at 30 and out at 20 lb. If it is desired to run all the rooms a trifle colder, as summer comes along, for instance, the cut-off point can be lowered in a moment's time and it is not necessary to bother adjusting the thermoexpansion valves or the thermostats.

This installation is in a town 60 miles away and gets very little attention, but in three years it has given no trouble except for one expansion valve which failed. Each thermo valve has a manually operated by-pass, so the butcher in charge was able to use the hand control until he received a replacement. A local man does the oiling of compressor and motor and puts in more ammonia when necessary.

The cost of the thermostats, magnetic valves and the low pressure control amounted to less than $50 per room. I would like the opinions of some refrigeration men on this installation. It was easy to get in adjustment, does the job and gives no trouble, but may have hidden disadvantages that I don't see. The compressor runs about the same number of hours as it did with the original system, but it is now providing real refrigeration.

The plant is shut down for defrosting. In the event that it would be more desirable to defrost the coils in each room separately I would suggest the addition of a two-bit single pole tumbler switch in the circuit between the thermostat and the magnetic valve on each room. For the benefit of butchers who are averse to "foolin' with valves," not mechanically inclined and not wanting to be, I would mark each switch plate "Cold" and "Defrost" for the on and off-positions. In an isolated plant such as this I have found it is cheap insurance to use an inexpensive locking device on the thermostats, so they cannot be changed except on orders of the department manager. This may save a carload of vegetables that some forgetful clerk thinks ought to be cooled in a hurry.

Flagstaff, Ariz. H. S. SYKES

How Would You Do It?

PROBLEM 32. MIXING COAL AND COKE BREEZE

APPARENTLY Our Hero is not the only one who has the problem of mixing coal and coke breeze for burning on a stoker, which he outlined in the January issue. A number of other engineers have either been considering what they could or should do about it or have actually developed some practical method of mixing these two fuels in their own plants.

Our Hero, as you will doubtless remember, was not concerned so much with the problems involved in burning the mixture of coal and coke breeze as in finding the best method of mixing it uniformly and delivering it to his stoker. He said he was getting very satisfactory combustion results with a 50-50 mixture. But how to maintain this mixture uniformly?

He has a new steam generating unit, fired by a spreader stoker. The coal and coke breeze are delivered by railroad car and stored on the ground by a portable conveyor or delivered to a track hopper from which a bucket conveyor elevates them to overhead bunkers in the boiler room. These bunkers have several compartments, each with its own fuel gate, so that the two fuels can be bunkered separately. From the bunkers, a weigh larry delivers fuel to the stoker hoppers.

Our Hero figured that mixing the coal and coke breeze by manual labor was too crude and costly, especially with labor hard to get. Also he has found that having the larry deliver a load of each fuel alternately to the stoker does not give good mixing.

The prize winning awards all emphasized the mixing of the coal and coke breeze in chutes or in the weigh larry or stoker hopper.

C. G. Clark mentioned so many of the methods by which the mixing could be done, and covered them so succinctly but clearly, that his letter was adjudged the best. He recommended the simplest method of all—and it so happens that we have just learned of two or three similar cases in which his method is actually in successful use.

One important factor Mr. Clark mentioned in his solution is that any tendency of either fuel to arch or hang up in the various hoppers or chutes must be taken into account in any scheme that is adopted. This tendency will vary with many factors in fuel and plant layout. Another contestant also mentions this.

George A. Aiken expects to be faced with this problem when he is able to install a new steam generating unit after the war. So he has been giving considerable thought to it and his complete coverage of several methods and his detailed sketches, the Judges thought, entitled him to second prize.

Regarding Wm. T. Mullen's idea of the chute with mixing plates in it, the Old Guys thought this would be a good idea if you had a long enough chute from bunkers to weigh larry. The mixing plates might not be so much help, they thought, if you got a lot of wet coal or if the coal arched or hung up in those spaces between the plates. But a vibrator would probably cure that.

P. Wagner certainly would have been in the running for one of the prizes if his letter had not been mailed later than the time specified and arrived after the prizes had been awarded.

Use of screw conveyors as advocated by Mr. Aiken, by A. H. Barnes and by Henry Leopold would without question give good control of the mixture of the two fuels, for the conveyor speeds could be varied. However, the Judges felt that under present conditions this was a little too much equipment, especially in view of the good results reported by other contestants in mixing the fuels in chutes, weigh larry or stoker hopper.

FIRST PRIZE AWARD

C. G. Clark
St. John, N. B., Canada

SEVERAL FACTORS affect the mixing of two different fuels in exact proportions. Chief among these are the variations in size and the moisture content. If there are large differences in size, especially in one fuel, any handling after mixing in which the fuel forms an upright or inverted cone will result in segregation and variations in mix ratio. Moisture will decrease the subsequent segregation but will not eliminate it. An oil spray treatment will also decrease segregation without greatly increasing the cost.

The problem as given does not state whether or not yard storage space and reclaiming equipment are such that both fuels can be kept completely separated but it is assumed that this is possible. To control mixing the identity of the fuel at each stage from cars to stoker hopper must be definitely known.

There are a great many possible solutions, which may be generally classified as follows:

1. Have fuel mixed by the seller and delivered ready for use.

2. Mix fuel in yard as stored, by spreading in alternate thin layers with storage equipment. This would involve other means for mixing fuel passing directly from cars to bunker.

3. Keep fuels separate in yard storage and mix by feeding alternate layers to all bunker pockets.

4. Keep fuels separate in yard and bunker pockets and mix in weigh larry. This would involve conveying equipment to feed simultaneously from two bunker pockets to larry between weigh larry and bunker. These conveyors could be mounted on larry and could be belt conveyors or chutes depending on the head room available. It would be necessary to always store the same fuel in a given bunker pocket.

5. Keep fuels separate at all times until fed to stoker hopper. This method would involve two small storage bins, or one divided bin above each spreader stoker unit, with adjustable and pref-

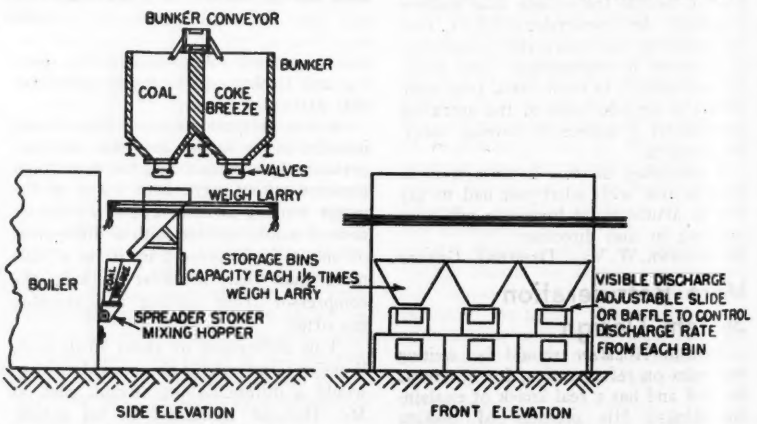


Fig. 1. Sketch by C. G. Clark, showing method he recommends as most definite to control and check: Partition stoker hopper and mix the two fuels there

erably visible discharge from each. Each bin would be filled in turn with the proper fuel from the appropriate bunker pocket, which would always have only one fuel in it.

Methods 1 to 4 inclusive would produce conical shaped piles after mixing. The size of each fuel (as affecting the tendency to segregate) and the accuracy of mixing economically justified would determine which, if any, of these methods should be used.

Method 5 is suggested as being the most definite to control and check in operation. This method is illustrated by the accompanying sketch. The exact bin shape will vary with details of the existing installation. The tendency of the fuel to arch in bins and hoppers must be considered in the final design especially if moisture content increases greatly in yard storage. Provision should be made for dislodging fuel restrictions in stoker bins with vibrators, agitators, or manually through suitably located openings.

SECOND PRIZE AWARD

George A. Aiken
Mead Corp., Wheelwright Div.
No. Leominster, Mass.

PROBLEM No. 32 interests me very much, for I may have a similar problem to solve in the post-war days ahead, when we expect to install another steam generating unit at this mill.

I have in mind four arrangements for the above problem. They are shown on the sketches Figs. 2 to 5.

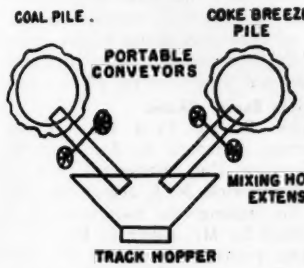


Fig. 2. Plan No. 1 by George A. Aiken. Mix the fuels at the track hopper by using two portable conveyors

No. 1. As the simplest arrangement, I would suggest having two storage piles, one of coal and one of breeze. If possible, buy, rent, lease, etc., another portable conveyor. Use one conveyor to carry the coal, the other to carry the breeze, to an extended hopper located over the track hopper. Both conveyors to be started together.

No. 2. If the bunkers are of, say, four compartments, a simple way, provided there is space enough between the bottom of the coal bunkers and the traveling weigh larry, would be to connect the two nearest bunkers, each containing coal and breeze, with a Y chute, with a main fuel gate, terminating over the weigh larry. This would do if there is enough pitch to the individual lines, leading from each bunker to the Y connection, so that the fuels would flow.

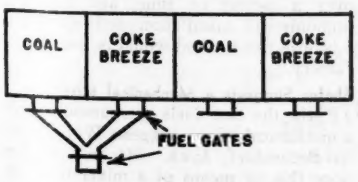


Fig. 3. Aiken's Plan No. 2. The fuels mix in a Y connection between bunkers and larry

No. 3. Where there is not head room and consequently not enough pitch to use Plan No. 2, a trough is attached to the fuel-gate outlets from the two nearest bins. Within this trough is a worm-feeder screw. The worm-feed screw is driven by a motor attached at one end. The feed screw has two sets of flights, one pulling and one pushing. They can be joined in the center, so that if one should wear faster than the other, it would be easier to dismantle them. At the center or the bottom of the trough or tube, is an opening with a fuel gate, which empties into the weigh larry. The feeder screw flights terminate a short distance away from the central opening in the trough or tube. See Fig. 4.

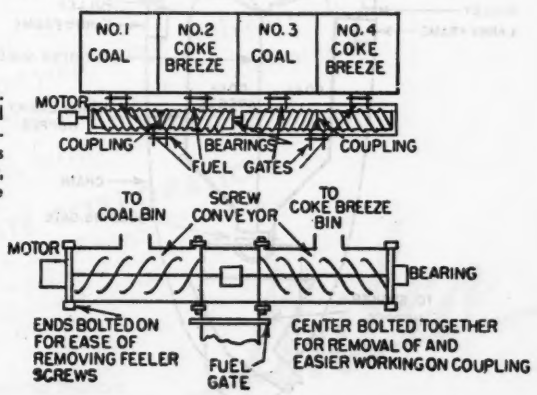
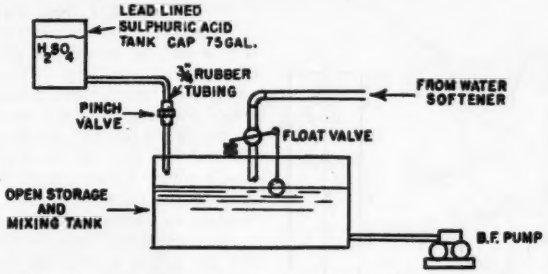


Fig. 4. Aiken's Plan No. 3. Screw conveyors feed fuels in desired proportions, mixing them as they discharge to larry, where they mix some more

Problem 33
Regulating Sulphuric Acid Feed



Our Hero is having feedwater trouble and, as usual, is yelling for help. Quite recently, he installed a new water softening system, which apparently works satisfactorily but leaves the water too much on the alkaline side. Someone told him to add sulphuric acid to the softened water, which works swell in reducing the alkalinity but he finds it difficult to control. The load on the boilers is quite variable and even though the water in the storage tank is float controlled, the level varies somewhat. The flow of sulphuric acid also varies as the level of the acid in the lead-lined acid tank falls. Our Hero put a pinch valve on a short length of rubber tubing in the acid feed line but it is a nuisance to have to watch and adjust it all the time. What sort of valve or other regulating arrangement can he rig up—something that would not cost too much—that would feed the acid automatically in proportion to the amount of feedwater drawn by the boiler feed pumps?

Suppose, this was your problem; how would you go about solving it? Write out your solution in a letter of not over 1000 words, illustrating your ideas with diagrams if necessary. We will award a $25.00 war bond for the best solution and prizes of $10.00 and $5.00 respectively for the second and third best solutions.

Entries for this contest should be mailed not later than March 31 and should be marked Problem 33. Address all letters to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago 4, Illinois.

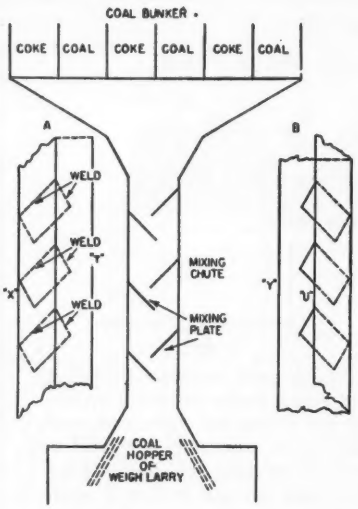


Fig. 5. Wm. T. Mullen's design for a mixing chute with deflecting plates, leading from the overhead bunkers

DUPLICATE THIRD PRIZE AWARD

Wm. T. Mullen
4240 Pennsgrove St.
Philadelphia 4, Pa.

Our Hero sure can get some problems and they make the readers look forward to the following issues to see what will be next. I hope the idea shown in the sketch, Fig. 5, will be some help to Our Hero.

The principle is that by the change of direction in the chute, the coal will be mixed sufficiently, not once but several times. By having the bottom of the chute shaped as in the sketch, as the coal falls in a pile into the hopper, it again mixes.

This chute would be made of heavy sheet metal, with the deflectors as shown in "a" and "b"; then, after the welding of these deflectors on the angle-shaped sheet metal, the edges can be welded—"x" to "y" and "t" to "u". This will complete the mixing chamber or chute, except for the bottom.

DUPLICATE THIRD PRIZE AWARD

Charles Bunce
86 Locust Avenue
Islip, L. I., New York

I believe the most economical solution would be to weld a dividing sheet of say ¼-in. steel, cut to size and shape and placed length-ways through the center of the hopper of the weigh larry, so as to subdivide the hopper in halves. To the top edge of this same plate I would hinge a short chute to cover the area of the clam mouth or gate on the bunker, as shown in Fig. 6.

In operation, suitable compensation for the added weight could be made on the scale. Then a charge of coal or coke could be weighed in one-half of the hopper, then the larry shifted, the short chute on top moved to the opposite side and the remaining half of the hopper filled.

The larry is then shifted to position for unloading, the dumping gate opened and the larry run back and forth across the stoker hopper being filled, this procedure making for even better distribution.

If a more elaborate arrangement, with accompanying larger expenditure is desired, the bunker itself could be divided in much the same way.

Wagner Loads Larry Hopper with Alternate Layers

At his plant, says P. Wagner, supervising stationary engineer, Lincoln Park Powerhouse, Chicago, Ill., he has an overhead coal bunker with two compartments, each with 3 fuel gates, with bucket elevators and screw conveyors and weigh larry, something on the same order as Our Hero's, also a spreader stoker. Coal is stored in one compartment of the bunker and the coke breeze is stored in the other.

"When burning ⅜-in. x 48-mesh screenings and coke breeze," he says "using the weigh larry I take a load of 200 lb of screenings from one compartment and then a load of 200 lb of coke breeze from the other compartment. The weigh larry holds 1 ton; in this way there is 1000 lb of screenings and 1000 lb of coke breeze in alternate layers.

"When the chute on the larry is opened, the coal and coke are mixed on the way to the stoker hopper. As this mixture is fed to the rotors on the stoker, it mixes further as it slides down the stoker hopper.

"When using ¾-in. x 10-mesh screenings and coke breeze, I use a mixture of 200 lb of screenings to 300 lb of coke breeze. I have had very good results with the above mixtures. I have found that the larger the coal is in size, the more coke must be added to get the proper mixture."

Barnes Advocates Screw Conveyors

A. H. Barnes, 519 Columbia Ave., Leavenworth, Kans., has numerous ideas on how Our Hero's problem could be solved. One is to purchase another portable conveyor and run the two conveyors at the same time, with one carrying coal and the other coke breeze and supplying the main elevator or conveyor that supplies the overhead bins similar to Fig. 2. However, this arrangement would not give a very uniform mixture, he thinks. Satisfactory results, he thinks, would be produced by using two motors, two reduction gear boxes and two screw-type conveyors, one right hand and one left hand in the same manner as suggested by Aiken in Fig. 4. The motors can be wired to start and stop at the same time and the starting switch may be connected to the fuel gate opening lever. In this way, the motors operate only when the fuel gate is opened.

This arrangement requires a minimum of head room which he has always found to be a premium where overhead bunkers and weigh larries are installed.

Mixing in Bunker Chutes

From Private First Class Robert Lieberman, Company A, Army Specialist Training Unit, Rutgers University, New Brunswick, N. J., comes the same idea for mixing the two fuels as is suggested by Mr. Aiken in Fig. 3.

"The problem of mixing the fuels uniformly," says Private Lieberman, "can be solved by using the proper ratio of areas of the openings of two adjacent bunker compartments. The actual area of the openings may be varied to suit the installation as long as the ratio is maintained. This area ratio may be determined quite easily by experiment. The problem of mixing these two discharges uniformly can then be solved by merely running the discharges an equal distance and allowing them to mix as they fall into the weigh larry.

"There are factors which will affect the accuracy of the ratio, such as the uniformity of the size of the coal and coke breeze. But due to the averaging over a period of time, and also the economy of installation and operation, I believe this method would be very satisfactory."

Shafer Suggests a Mechanical Mixer

Mix the two fuels mechanically with a mechanical mixer, suggests Wm. Shafer of Bettendorf, Iowa. He says he has done this by means of a mixer made of odds and ends as shown in Fig. 7 and it works very well. It is, of course,

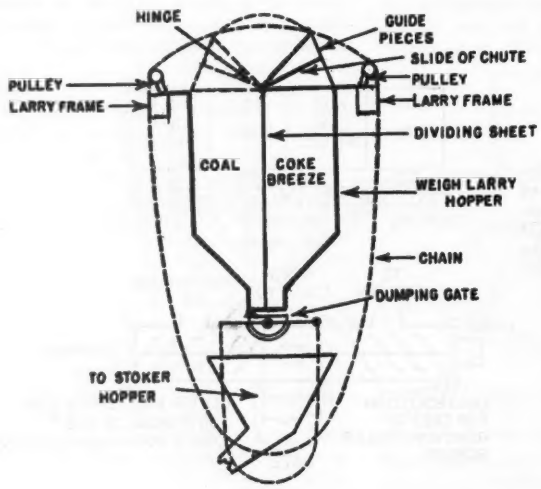


Fig. 6. How Charles Bunce would divide the weigh larry hopper to mix the two fuels

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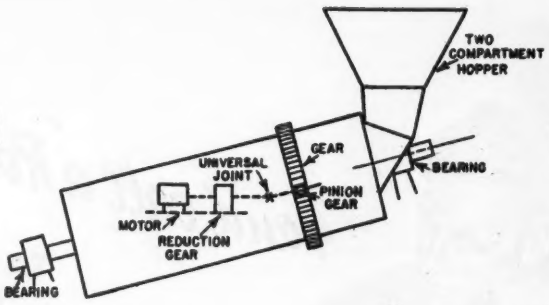


Fig. 7. A mechanical mixer, made of odds and ends, is advocated by Wm. Shafer

nothing but the principle of the concrete mixer; perhaps an old concrete mixer would do the job, if one were available.

"As the flow of fuel through the mixer would be continuous," says Mr. Shafer, "the apparatus would not have to be very large compared to the other equipment to handle the same capacity. It could be built very rugged, there aren't any delicate parts. Once started, it would require no additional labor to operate, and power consumption would be small compared to amount of work done.

"With the fuel handling equipment as described, I believe this type of mixer could be installed with little if any alterations to the present set-up."

Henry Leopold Proposes Screw Conveyors at Track Hopper

Extend the conveyor along the railroad track to accommodate two railroad cars, one car loaded with coke breeze, the other with coal. Build a hopper under each car and install a length of 9-in. or 10-in. screw conveyor in the bottom of each hopper so as to extend out and discharge into the conveyor leading to the elevator. Place two sprocket wheels on one shaft end of one screw conveyor and place one sprocket wheel on the shaft of the other screw. Then drive one through a reducing gear and chain and the other from the sprocket on the one that has two sprocket wheels. By selecting the proper size sprocket wheels, one could get a 50-50 mixture or almost any other mixture desired.

This arrangement, properly installed, should give Our Hero most perfect results, says Henry Leopold, Southern Extract Co., P. O. Box No. 238, Knoxville, Tenn. The cost of installation he says, would well pay for itself in the saving of fuel by providing the proper mixture for good combustion.

"My idea," comments Harlie Hillard of 201 Briscoe St., Jackson, Mich., "is to have two cars of fuel unloaded at one time or run from two piles, one of breeze and the other of coal, by using two conveyors which will empty into a fuel bin at the top of a tower. Both conveyors will run at the same speed and be loaded as evenly as possible to get a 50-50 mixture.

"At the bottom of the fuel bin have a spiral chute lead from the bin to the ground, or to the conveyor that goes to the boiler room bunkers. As the fuel is run down the spiral chute, it should mix quite well. A gate at the bottom of the bin to regulate the flow of the fuel to the chute would keep the spiral chute from overflowing."

Wright Would Do It with the Bucket Conveyor

An ingenious and simple method of mixing the fuels by using the conveyor is suggested by William J. Wright, operating engineer, The Procter & Gamble Mfg. Co., St. Louis, Mo.

"Inasmuch as the coal bunker is divided into several different compartments each with its own fuel gate, coal may be run up into one and the coke breeze into another compartment. The gates could then be adjusted to supply equal amounts of each fuel into chutes, allowing it to drop through a grating in the floor into the bottom run of the bucket conveyor. The mixed fuel could then be dumped into a third compartment in the bunker and drawn as needed into the weigh larry for distribution to boilers.

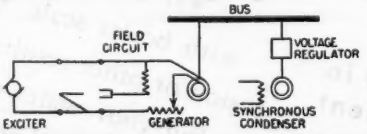
"This arrangement is based on the bunker being properly hoppered and a reasonably dry and free running fuel. Otherwise a vibrator, such as a Syntron, will have to be used to keep the fuel flowing freely. If the use of chutes is not practical on account of space limitations, the fuels could be dropped directly into portable hoppers set over the gratings."

Questions And Answers

Question No. 252

What Will Happen to the Megavars—and Why?

THE GENERATOR in our plant is connected to the same bus with a synchronous condenser, as shown in the sketch. The reactive on the generator is, of course, lagging. The leading reactive on the synchronous condenser varies with the system load, for it is equipped with a voltage regulator, and maintains a steady bus voltage. The generator has no voltage regulator.



Sketch of R.F.L.'s generator and synchronous condenser connections. How would generator field manipulation affect condenser megavars?

Now here is the question: What would happen to the synchronous condenser, as far as the amount of leading megavars is concerned, if the field control on the generator is manipulated to change the field strength and make the reactive on the generator leading instead of lagging?

Bus voltage would tend not to change, because the synchronous condenser voltage regulator would maintain normal bus voltage. But what would the megavars on the condenser do: increase, decrease or remain the same?

Evansville, Ind. R. F. L.

Question No. 253

Who Knows About Flash Type Boilers?

FOR GENERATING a small amount of high pressure steam, say between 1000 and 3000 lb per hr at around 600 psi, to use in a certain apparatus we are developing, it has been suggested that a boiler of the flash type might be the solution. Can readers give us any details of design or performance of such boilers that would help us?

As I remember it, the old Stanley steam car used a boiler of this type. There was another steam automobile called the Doble, I believe, but I don't know what type of boiler it used. Any data on these or similar boiler units would help us.

Buffalo, N. Y. J. S. L.

Editor's Note: We have referred the above inquirer to the U. S. Navy for data on the old Ward flash type boilers used many years ago on the old 40-ft and 50-ft steam cutters, now almost entirely superseded by internal combustion engine driven motor-sailers. We have also referred him to some material published many years ago on the steam automobile. However, we should like to have further comments from readers who may have accumulated information.

Also, do readers have any information about small boilers using the continuous flow principle, or using standard boiler circulating principles, that might be used by the above reader instead of a flash boiler?

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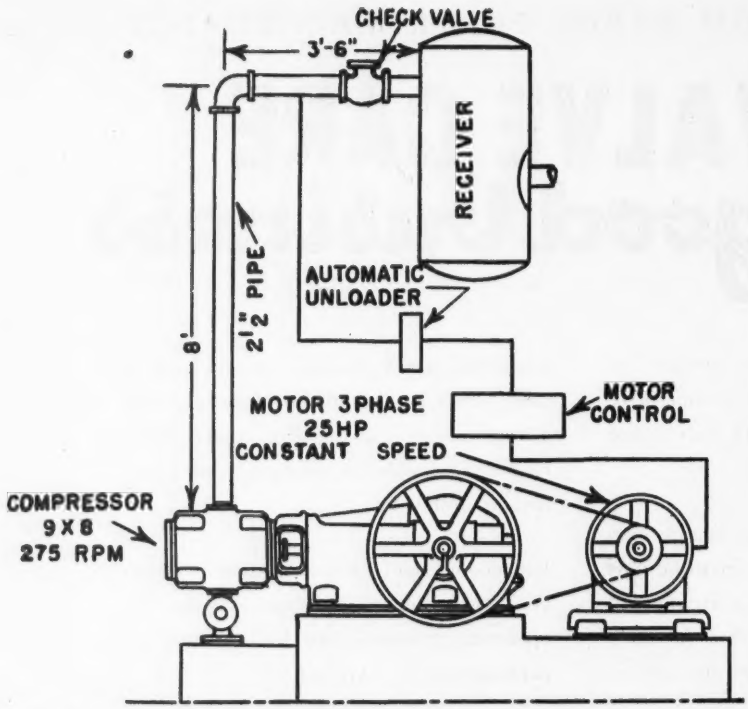

Sketch of A. J. K.'s air compressor installation, showing check valve that makes annoying noise as compressor shuts down at frequent intervals

Question No. 254

Church Bell in Compressor Discharge Produces Bats in Engineer's Belfry

SLOWLY but surely we are being driven nuts by the unearthly racket caused by the continual slamming of a check valve in the discharge line between our air compressor and receiver, as shown in the sketch. This valve could be used for a church bell the way it is now. Here's the story.

Our 9-by-8-in. compressor is belt-driven from a 25-hp constant-speed motor, as shown. An automatic unloader is connected to discharge line and motor control so as to start and stop the driving motor at frequent intervals as the discharge line pressure varies from the set value—and that check valve goes "bong!" every time the compressor stops.

The check valve can be eliminated and has been in the past; but without it, motor and compressor start against load and that throws terrific abuse and strain on the belt. With the check valve installed, however, the compressor is unloaded up to the check when it stops. I feel that the check valve ought not to be used as shown, for even if it were not making such a terrific noise, such rough treatment will render any check valve useless in a short time.

So the problem is: how can this compressor be unloaded when it stops periodically, without all the racket from the check valve and at the same time without losing the pressure in the receiver? Yours for tougher ear drums and fewer bats in the belfry.

Minneapolis, Minn. A. J. K.

Answer No. 244

Why Does HRT Setting Crack and Bulge?

WHAT WOULD cause the outside walls of a practically new HRT boiler setting to crack and bulge so badly that they are practically collapsing? asked R. J. R. in the January issue. It is the setting of a 2-boiler battery and is equipped with buckstays. Boilers are supported from overhead steel work. Where can he get a set of directions or specifications for building HRT settings correctly, he asked, so he can check up this job to see what caused it to collapse?

Apparently it isn't easy to find such a thing as a set of standard directions or specifications by which such settings can be judged, because so much depends on the knowledge and experience of the contractors and the masons who lay up the walls, as well as a number of other variable factors. There are, of course, some general principles to be followed, as indicated in the comments given below.

Our primary object in publishing this question was to attempt to bring out the facts an engineer ought to know so he can judge whether an HRT setting is properly built or not. There are many HRT boilers installed in all types of plants and, considering the large amount of steam they make and the amount of fuel burned under them, we wonder why more engineering attention has not been given to their settings. These are usually solid wall settings and usually contain much more brickwork than settings for water-tube boilers of the same or even higher capacity. In recent years, many of them have been equipped with suspended-wall furnace enclosures and we plan to present some data on these in the near future.

We regret that, because of various factors now beyond the control of R. J. R., it is impossible at this time to obtain any photographs or sketches to show the present conditions of the setting or to obtain the original specifications or blueprints to which it was originally built.

Good Foundations, Good Design, Good Construction Are Necessary, Says Martin

THREE important factors must be considered when designing brickwork boiler settings: 1, The right support or foundation for the shell, which must be arranged to allow for proper expansion of the boiler; 2, proper arrangement of furnace flues and ash-pit; 3, a covering that will prevent loss of heat by radiation, and at the same time will not allow moisture to accumulate where it may come in contact with the plates.

One method of support is by brackets riveted to the shell plate; the other method by suspension from overhead girders by using hooks, rings, etc. Whatever support is used, it should be so designed that it will bear its proper proportion of the load, and will, at the same time allow for expansion. Short boilers are generally supported by brackets, while long, plain cylindrical boilers utilize the girder. If very long cylindrical boilers are supported only at the ends, the great weight between the two end supports will cause bending and excessive strain on the middle plates, a tension in the bottom plates, and compression in the top plates.

A good foundation is the first requisite for a boiler setting. If tests show that the ground is in firm and favorable condition, the excavation need only be dug to a depth of 3 or 4 ft below the ground level. Where the ground is soft, the excavation should be deeper, and the extra depth filled in with broken stone mixed with cement, gravel, etc. For very heavy settings piles may be driven. Some builders use large stones laid in cement; upon this stonework the walls are constructed from stone or brick, to within about 6 in. of the proposed floor level; and above this wall brick should be used.

Foundation beds are sometimes made of concrete about 3 ft thick. However, no foundation will stand up unless it is properly SET.

Estimates should be carefully made on the weight that is to be distributed over an area. With an ordinary condition of soil, this should not exceed 2000 lb per sq ft. For greater weights, a special construction must be used.

Outer walls at the sides and rear should be double, with an air-space in-

Edward CHECK VALVES

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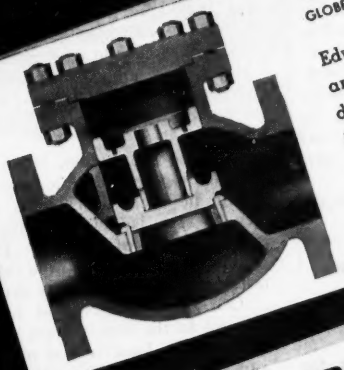
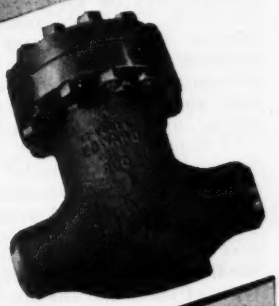
GLOBE AND ANGLE, 2½" to 14" 150 LB TO 2500 LB SP





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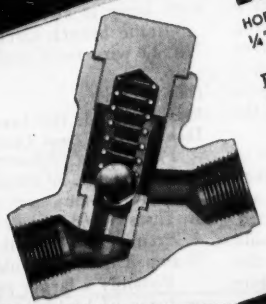

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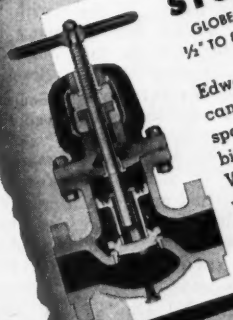
STOP-CHECKS

GLOBE, ANGLE AND SEPARATED ½" TO 8" 150 LB TO 2500 LB SP



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sulation of 2 in., to prevent loss of heat. The projecting bricks, which extend from the outer until they just touch the inner wall, allow for expansion without decreasing the strength of the inner wall. Buckstays or binders, used to support the side walls, are kept in place by long rods, secured by nuts on each end.

Bad workmanship in laying the brick is one of the main reasons of wall collapse from the expansive powers of the brick. However, failure through chemical disintegration may be caused by brick containing a high percentage of iron oxide. The greatest cause of arch and wall failures is due to the mortar joints being excessively large.

I suggest that R. J. R. contact the manufacturer of the boiler for proper specifications and blueprints. He might also try the National Association of Power Engineers, many of whose members have licked this problem; they handle this type of equipment under types of loads and conditions that not even the most expert boiler bricklayer would have time or chance to observe.

Fairview, N. J. MARTIN N. GOZDENOVICH

Brown Discusses General Principles of Setting Construction

If R. J. R.'s boiler settings crack and bulge, as badly as his question states, he sure must be in plenty of trouble.

He probably could obtain a blueprint for setting HRT boilers from Hartford Steam Boiler Inspection & Insurance Co., or Erie City Iron Works, Erie, Pa.

There could be several things wrong. Maybe he didn't dig down to solid ground when he poured his concrete foundation for the brickwork to set on. Perhaps the mortar or the cement froze before it set. There could have been too much mortar put between the red brick and the fire brick.

He says that the boilers are suspended from overhead steelwork. But he doesn't say that they aren't supported on the masonry itself. If the weight of those two boilers full of water were allowed to rest on the masonry, something would bulge somewhere, unless the masonry was made for suspension. I have seen several settings that were set up that way, but like R. J. R.'s they all had cracks in the walls.

I believe that the correct procedure is suspension of the boilers on steel I-beams of the proper width and length, supported by cast iron columns set on a suitable concrete foundation.

R. J. R. didn't say what kind of prime mover he had. Sometimes the pulsations from a Corliss engine will set up vibrations in the boiler piping severe enough to make the settings crack.

Maybe the overhead steelwork mentioned by R. J. R. has a habit of moving about, as would be the case if the boilers were used in a saw mill, where there was a steam-operated carriage. As the thrusts from the reversal of the carriage would move the entire building, just a little, if part of the building was constructed of wood timbers. Such was the case in a small saw mill plant where I worked at one time. But I expect that R. J. R.'s power plant is a lot more modern than that one was.

Perhaps he tightened his buckstay rods too much while the setting was cold. This would cause the brickwork to snake, for the buckstay rods wouldn't get hot as fast as the firebrick inside the furnace.

If R. J. R. had given a sketch of his setting, showing cracks and all other details such as the depth and width of cement foundation, etc., the picture would have been much clearer.

He doesn't say anything about the fireman putting out the fire with the fire hose or using the hose to cool the inside of the combustion chamber so that he could get inside in a hurry, perhaps to change a grate or roll a few tubes. This kind of rapid cooling never seems to help the brickwork.

Maybe the setting was built up without enough tie courses or too much fire clay between the joints. Dipping the fire bricks in a thin solution of fire clay or refractory cement seems to give good results.

Sloat, Calif. ROY L. BROWN

Answer No. 245

More About Fuses: How Should This Circuit Be Fused?

WE JUST shoot that question at the Q & A readers and they come at us brandishing their typewriters and fountain pens, and mowing us down with the cold dope on fuses. The interest such questions arouse is a good indication of the importance of fuses, as was shown last month by the comments on Question No. 222.

This time we have some comments on C. E.'s question in the January issue. He asked if a 75-amp switch fused with two 75-amp fuses or a 100-amp switch with two 50-amp fuses should be used on a two-wire a-c lighting circuit carrying 62 amp? The comments agree pretty closely on the fundamental points.

Gould Says 70-Amp Fuses and 100-Amp Switch

C. E. IS CORRECT in saying that the same amount of current flows from a resistance as flows to it. It is the drop in voltage necessary to cause a given amount of current to flow through a resistance (in this case the filaments of his lamps), that determines the amount of power used.

He did not say what his source of a-c power was, but it probably is taken from a public utility line. If so, one side of the 115-v line will be grounded. This grounded side of the line should not be opened at any point, unless the ungrounded side is opened at the same time.

The screw shells of the lamp holders are connected to the grounded side, which is identified by using a wire with white insulation. This prevents the chance of a man getting a shock by coming in contact with the screw

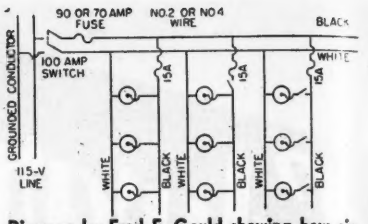

Diagram by Fred E. Gould showing how circuit should be fused if one side of 115-v line is grounded

shell of a lamp bulb when inserting lamps.

As the total load is 62 amp, a No. 4 circuit will be required. According to the National Electric Code, a No. 4 wire may carry up to 70 amp, so a 70-amp fuse should be used.

As all fuses from 61 to 100 amp have the same physical dimensions, a 100 amp switch would be required.

If the main line was made with No. 2 wire, the same switch could be used and fused up to 90 amp. This would allow additional load to be added if necessary.

In case the system is ungrounded, a double-pole, double-fused switch should be used, but if it is grounded, then a fuse is used in only the ungrounded side of the line. The switch could still be double-pole, as long as both blades opened at the same time.

Of course the No. 14 wire branch circuits to the lamps must be arranged so that the load is not over 15 amp, and be protected by a 15-amp fuse in both sides of the branch circuit.

If any switches are used to control individual lamps, they must be in the ungrounded side of the circuit.

Neither arrangement mentioned by C. E. is practical. In the first case, a 50-amp fuse could not be used in a 100-amp switch without using an adapter, and it would blow anyway as the load is 62 amp. In the second case, switches are not made in 75-amp sizes, the next size above 60 amp being 100 amp. Also there are no 75-amp fuses.

The accompanying diagram shows one branch circuit which is controlled by the main switch only, another which may be turned off as a group by a switch in the ungrounded conductor, and another branch circuit in which each lamp is switched individually.

If the branch circuits are run with No. 12 wire they could be fused at 20 amp.

Dalton, Mass. FRED E. GOULD

Fuses Should Be Not Less Than 70 Amp, Says Lauck

FROM THE information stated in C. E.'s inquiry, he should use not smaller than a 100-amp switch with a fuse or fuses rated not less than 70 amp. A circuit breaker with not less than a 70-amp trip also could be used.

Possibly a larger switch with a fuse or fuses of higher rating, or a circuit breaker with a trip or trips of higher rating, should be used. Further information regarding this installation would have to be known before it can be determined what size switch and what fuse rating or what size circuit breaker

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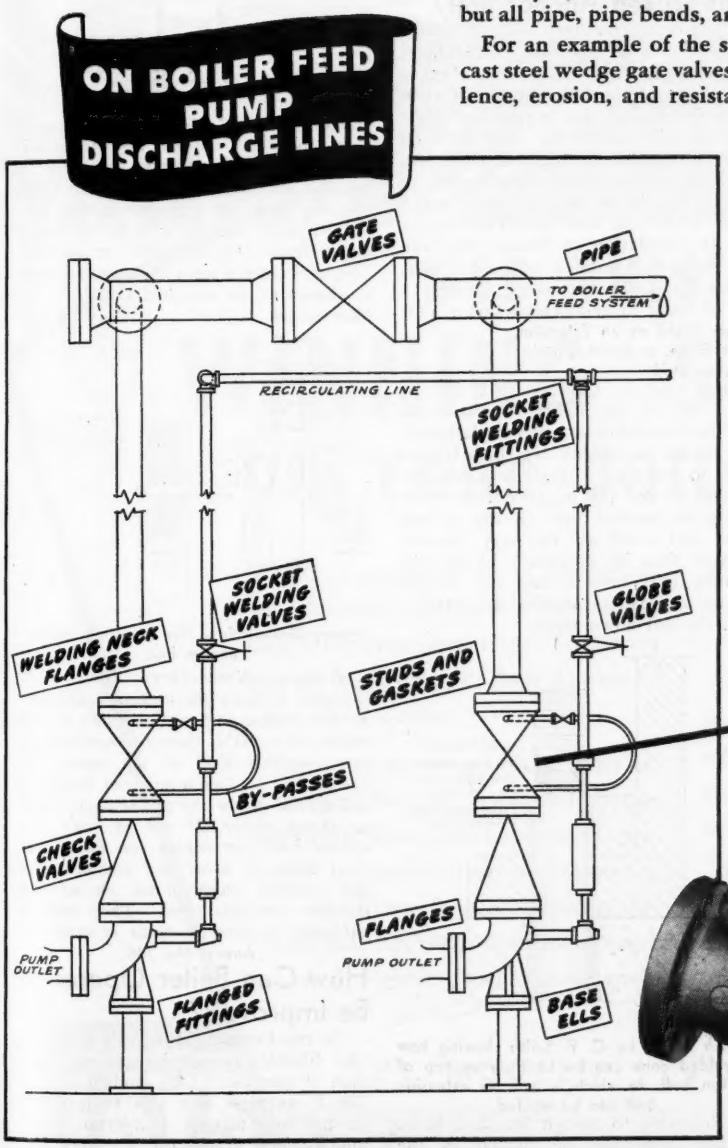

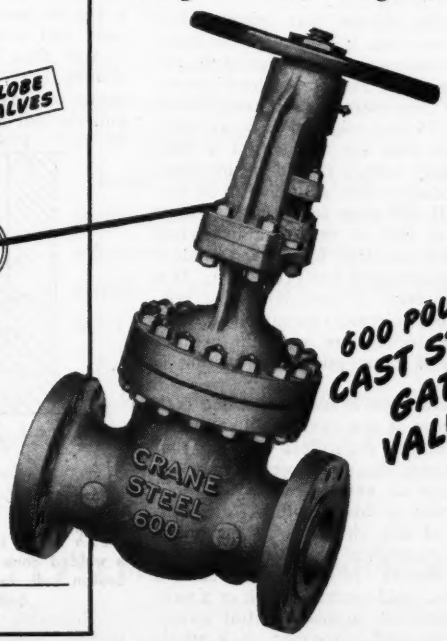

600 POUND CAST STEEL GATE VALVES

CRANE

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and what trip rating are entirely adequate and proper.

For instance, it should be determined that the conductors of this circuit are ample for the total *connected* load multiplied by the appropriate demand factors of Article 220 in the 1940 National Electrical Code and its latest supplement, or multiplied by some higher demand factors more appropriate to the actually existing conditions. Also the rating of the main buses on any panelboards connected to this circuit should be checked. Then, a fuse or fuses, or a circuit breaker with a trip or trips of the largest rating that will protect both the conductors and the panelboard buses should be used.

It is not entirely clear to me as to whether the 62 amp reported in this circuit is the maximum current that would flow with the entire load on or whether it represents an average loading that may be exceeded considerably at times. If this is determined, if adequate demand factors are applied, and if the conductor size is adequate for these conditions, fuse or circuit breaker trip selection on the basis suggested in this paragraph should permit carrying the load and also should provide adequate protection.

The size switch to be used will be determined by the size fuse selected in accordance with the paragraph above. That is, fuses 100 amp and smaller will suggest the installation of a 100 amp switch and fuses larger than 100 amp will require a 200 amp switch. It should be noted that switches are not made in a 75 amp size; standard sizes being 30, 60, 100, 200, 400, 600 . . . etc. amp.

Another factor that might affect switch selection is that most enclosed, fused switches are not designed to, and will not, carry their rated load continuously. Therefore, if a current above perhaps 75 amp might flow occasionally for more than say an hour at a time, a 200 amp switch should be installed. Fuse reducers then will have to be employed if 110 amp fuses (the smallest size that will fit in 200 amp switch clips) are too large for proper conductor or panelboard bus protection. If a circuit breaker is considered, the possible short-circuit current should be checked, to be sure a circuit breaker capable of interrupting that current is selected.

C. E. is right in his opinion that both conductors of this circuit will carry the same current, regardless of what that current may be. However, it may not be proper or even safe to fuse both conductors of this circuit. If one conductor of this circuit is a "grounded, neutral conductor" no fuse should be placed therein. If such is the case, a two-pole, solid-neutral switch or a two-pole, switched, unfused-neutral switch should be used. However, if a standard, two-pole switch is available, it may be used by bridging the fuse clips of the pole or "side" that is not to be fused, using a solid copper bar and bolting it securely in place, or by "bridging" both the switch and the fuse clip of that pole using a wire or a copper bar.

Topeka, Kan. P. O. LAUTZ

Gray Says 75-Amp Fuses

According to the National Fire Underwriters' Code, a 25 per cent overload is permissible on fuses installed in circuit switches. As the current in this circuit is 62 amp, the nearest size fuses for this service should be one-fourth larger or approximately 75 amp capacity. This would be sufficient in the event that the entire load is thrown on at once.

New York City EDWARD W. GRAY

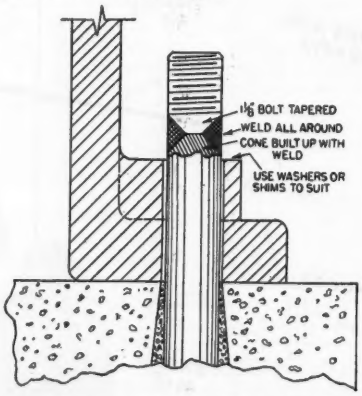
Answer No. 247

What Would You Do With This Broken Anchor Bolt?

IN TIGHTENING down the nuts on the anchor bolts of his two 75-hp Diesel engines, said C. I. P. in the February issue, one of the bolts broke off even with the top of the engine bed plate casting. He asked for comments on how to repair it, stating that there was no way to drill another hole without weakening the metal of the bed plate. Also, he did not want to lift the engine off its foundation to replace the bolt, for that would entail a long shut-down, which he could not afford, besides a lot of work in re-aligning the engine.

Either Weld on an Extension, Says Smith, or Insert Slightly Smaller Stud

REPLYING to Question No. 247 of C. I. P., in the February issue, the enclosed sketches are self-explanatory. As shown on Sketch No. 1, it is possible to build up a small cone of weld on top of the 1⅛ in. anchor bolt, set a 1⅛ in. tapered bolt on top of this cone and weld all the way around. It will then be necessary to file the welded bolt smooth and use several shims or washers around the weld to pull the nut down tight.



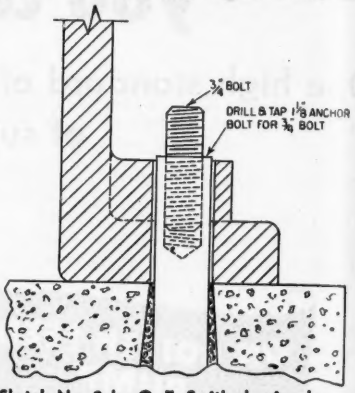
Sketch No. 1 by C. F. Smith showing how a welded cone can be built up on top of broken bolt, to which in turn an extension bolt can be welded

Referring to Sketch No. 2, a ¾-in. tapped hole can be drilled in the 1⅛ in. anchor bolt and a ¾-in. stud bolt inserted. This ¾-in. bolt should be sufficiently strong to hold the bed plate solid and prevent any excess vibration.

Saginaw, Mich. C. F. SMITH

Bolt Extension Can Be Screwed and Welded to Broken Bolt

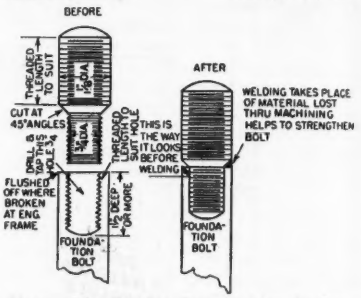
C. I. P. states he cannot afford a shutdown because the engine is badly needed. So I suggest he first flush the bolt as near to the engine frame as



Sketch No. 2 by C. F. Smith showing how a ¾-in. stud bolt can be used to extend broken bolt

possible with a grind stone. Then he can drill and tap a ¾-in. hole in the flushed bolt, and fit a ¾-in. bolt cut down from 1⅛ in. stock or another bolt, and finally weld the two together as shown in the attached sketch.

Camden, N. J. HENRY GRASSI


BEFORE
AFTER
THREADED LENGTH TO SUIT
CUT AT 45° ANGLES
DRILL & TAP ¾" HOLE
FLUSHED OFF WHERE BROKEN AT ENG. FRAME
FOUNDATION BOLT
THREADED LENGTH TO SUIT HOLE
THIS IS THE WAY IT LOOKS BEFORE WELDING
WELDING TAKES PLACE OF MATERIAL LOST THRU MACHINING HELPS TO STRENGTHEN BOLT
FOUNDATION BOLT

Henry Grassi's idea for repairing broken anchor bolt

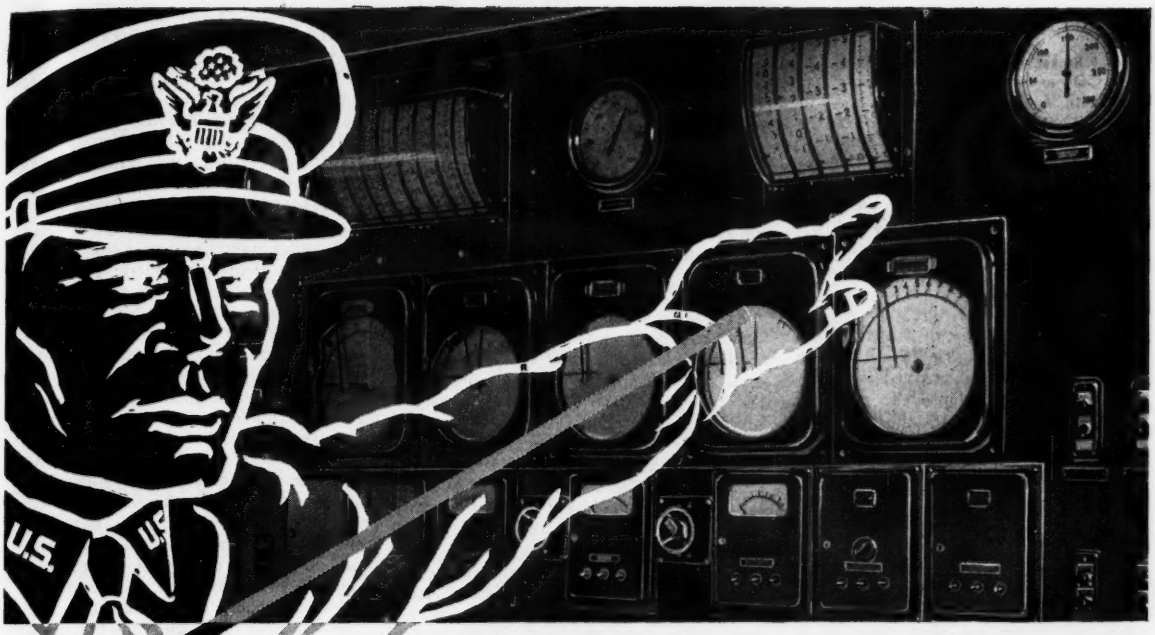
Editor's Note—There isn't much clearance between the vertical center line of the broken bolt and the side of the engine frame. Will there be enough room for a ratchet drill or tap wrench to operate? If so, then a hole can be drilled and tapped in the top of the anchor bolt as shown above. If not, it can't, for neither bolt nor engine can be moved.

A flood of ideas and comments on this question swept down on us just too late for this issue. They will be published as soon as space is available.

Answer No. 248

How Can Boiler Operation Be Improved?

IN THE February issue, J. S. R. asked: (A) Should he not be getting more than 9 per cent CO_2 and less than 560 F average flue gas temperature on his two 600-hp, four-drum, bent-tube boilers, fired with Northern Illinois 1-in. by ¼-in. wash nut on forced draft chain-grate stokers? (B) Why does fire on one stoker burn V-shaped, that is, one side 4 or 5 ft shorter than the other? (C) Should he insulate the 16 drum heads of these boilers,



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which were left uncovered when installed?

Correct Stoker Air Distribution Should Raise CO_2 and Prevent Uneven Fire, Says Smith

CONCERNING ITEM A, I would suggest, first of all, that he increase the CO_2 to about 13 or 14 per cent, thereby operating at a higher efficiency. When the CO_2 is raised, the flue gas temperature will automatically go down. At the present operating conditions of 9 per cent CO_2, he is operating very inefficiently.

From Item B of the question regarding the condition of the fuel bed, this could be the cause of the low CO_2. No doubt there is a great deal of excess air coming through the rear end of the stoker, due to the irregular burning of the fuel bed. In order to remedy this situation, the first step would be to check the wind box zoning in the rear of the stoker. It is entirely possible that too much air is being used at the back end of this chain-grate stoker, thus causing the low CO_2.

Another item to be checked on the wind-box zoning is to be sure that all zones are tight and that there is no leakage around them. It appears that there is too much burning on the rear of the stoker and that this burning rate should be increased nearer the front end, so as to leave a bed of ash on the rear of the grate. This can be accomplished by increasing the air through the front zones and decreasing it on the rear zones.

Another suggestion for operating this chain-grate stoker would be to experiment with a thicker bed and a slower stoker speed. It would then be necessary to use more air on the front zones and practically no air on the rear zones, thus doing a complete job of burning on the front two-thirds of the stoker.

Regarding the 16 bare drum heads on the two boilers, it would be in the best interest of economy to insulate these heads. It would also be more comfortable to work around the boiler with the heads covered.

Saginaw, Mich. C. F. SMITH

Answer No. 250

How Stop Fuel Waste in This Unit Heater System?

IN AN INDUSTRIAL plant, two boilers supply unit heaters of 65,000 sq ft of radiation surface with 75-100 psi steam. This is the only load on the boilers. The condensate returns come back so hot that large quantities of cold water must be fed into the return lines to cool the condensate down so the pumps can handle it. This produces so much feedwater that the boilers become flooded and have to be blown down frequently, wasting a great deal of fuel.

The unit heaters and main ends, he says, are all equipped with high-pressure bucket traps. Two 250-hp boilers supply the steam; there are two vacuum pumps on the return lines with a preheating tank above them, vented to atmosphere. The vacuum pumps deliver the return condensate to this preheating tank, from which the boiler feed pumps take suction.

H.E.S. says several things have been suggested to stop the fuel waste. Flash tanks and heat exchangers could absorb the surplus heat and make it available for process, but this is too expensive. Installation of pump governors and water level controllers has been advocated but this would not get rid of the excess water introduced to cool the returns. Installation of pressure-reducing valves to deliver low-pressure steam to the unit heaters has been proposed but the plant engineer does not approve this, for he does not like low-pressure steam for heating and does not believe the buildings can be heated satisfactorily on low-pressure.

H.E.S. also feels that the hot returns will soon ruin the pumps and asks if there is some special pump available designed to handle such hot condensate. Finally, he wants to know whether any or all of the above suggested remedies will cure the trouble and, if not, what is the best solution?

Parduhn Says Vacuum Pumps Unnecessary in This System

ON THE accompanying sketch, the lighter black lines indicate the connections as I understand you have them now and the heavy black lines indicate the suggestions which follow.

I cannot understand the use or need of a vacuum pump in the return line of a high pressure heating system. It stands to reason that the condensate that will gather in a trap will gather under boiler pressure. Therefore, the temperature of the water will be very near the temperature of the steam, and as soon as it's discharged into the return line having less than atmospheric pressure, it is reasonable to assume that it will flash into steam. Nothing has been said about a receiving tank, therefore I am assuming that the condensate is discharged directly into the vacuum pump and that, of course, indicates that an attempt was made to maintain a vacuum on the return line.

In my estimation, a vacuum on the return line is not necessary and the vacuum pump is also unnecessary. To prove the point would take but very little investment and a small amount of time. I suggest a by-pass be installed around the vacuum pump, as shown, and the vacuum pump be shut down.

Install a valve in the vent line from the pre-heater so that the vent may be closed. Install a relief valve, set at approximately 15 psi, on the pre-heater.

With this set-up, the traps from the unit heater will be discharged directly into the pre-heater at a pressure of about 5 or 10 psi. There is no reason why the traps should not function in this hook-up and the only difficulty I can see might arise out of the piping system being too small; i.e., the return lines may be too small in size since they were installed with the intention of including a vacuum pump in the line.

No mention has been made of the make-up line to the pre-heater, so I am showing a float-controlled, quick-opening valve, which would perform this service. It is evident that this plant would ordinarily use but very little make-up water but I suppose that some arrangements are made for that.

Chicago, Ill. W. J. PARDUHN

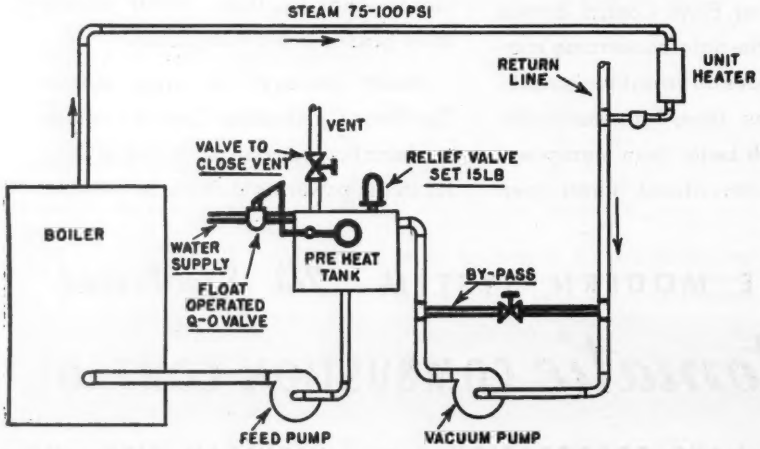
Gray Advocates Use of Low-Pressure Steam If Lines Are Right for It

THE PRESENT system of return from the unit heaters employs the use of high pressure traps. The writer has used high pressure bucket and thermostatic type traps successfully on a low-pressure gravity return to condensate pump closed systems.

Now, are the returns all above the condensate pump? If so, the proper solution would be to supply steam at reduced pressure IF the lines are big enough for the volume required. The consumption of steam in the heaters at 2 lb would not be much more than at 100 lb, the variant being greater condensate for a given period of time. Since the returns would be much cooler, the need for blowdown and the resulting fuel waste would be eliminated.

The most important consideration is the fuel, and even if the engineer doesn't like low-pressure, that always should be the controlling factor.

New York, N. Y. EDWARD W. GRAY



Sketch by W. J. Parduhn showing in heavy lines how vacuum pumps should be by-passed and preheater tank connected to receive condensate direct from high-pressure traps

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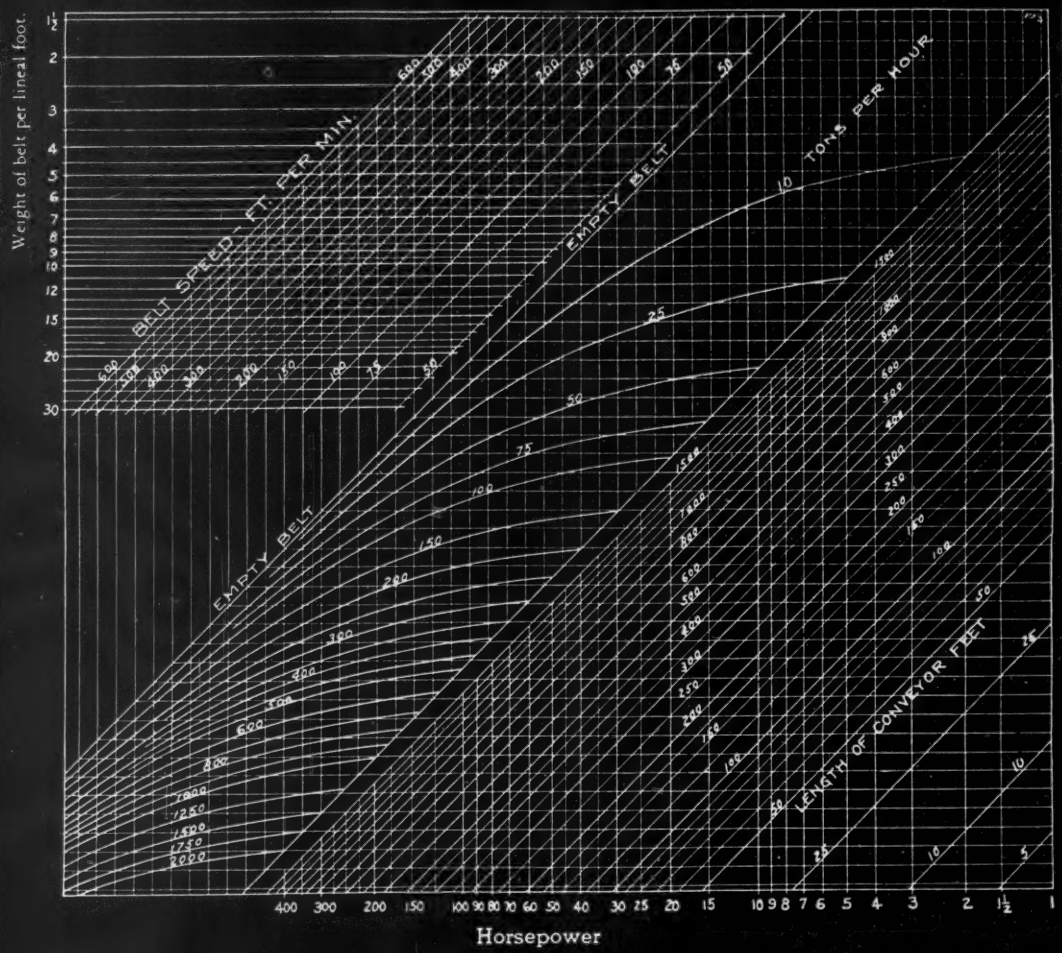
Horse Power for Belt Conveyors

$$H.P. = \frac{C\,L}{10{,}000}\,(.06WS + T) + (H.P.\ \text{for lift}) + (H.P.\ \text{for Tripper}).$$

L = Length of conveyors in feet. W = Weight of belt per lineal foot. C = Factor for belt width.
S = Feet per minute speed of belt. T = Tons per hour material carried.



To use Chart:

Find weight of belt on scale at left. Trace right to speed line, then down to curve of tons per hour (or to straight line for empty belt if conveyor without load is considered). Then right to intersection with length of conveyor, then down to lower scale, noting horsepower. Multiply by factor "C" corresponding to belt width as follows:

12"–1.36	16"–1.32	20"–1.28	30"–1.18	42"–1.06	54"–.95
14"–1.34	18"–1.30	24"–1.24	36"–1.12	48"–1.00	60"–.90

Horsepower thus found is for horizontal conveyor equipped with plain bearing idlers. Reduce 50% for Dodge-Timken idlers.

INCLINED CONVEYORS

For inclined conveyors use actual incline length of conveyor and find horsepower as for horizontal conveyor. Add horsepower to lift load the required height. H.P. = .001T x lift in feet.

TRIPPERS

Add for each stationary tripper H.P. = .005T or for each traveling tripper H.P. = .005T + ½.

Total horsepower thus found is horsepower at driving pulley; use this for determining plies of belt and pull on shaft as per chart on following page. For size motor required add to above horsepower 10% for each cast tooth gear reduction or common chain drive. Add 5% for each cut tooth gear reduction, belt or chain drive using cut tooth sprockets. Consider efficiency of any speed reducing units used. Use standard motor equal to or next larger than total horsepower thus found.

The Chart is presented here by special permission of the Dodge Manufacturing Corp., Mishawaka, Ind.

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Knock Out Ring Trouble... Carbon!

help reduce "down-time"... cut oil consumption

Top-flight performance of the diesels in this plant was being challenged by excessive carbon deposits and stuck rings.

Production schedules were interrupted because of power shutdowns. All too frequently the diesels had to be taken down to remove excessive carbon. Down-time was extended because of stuck piston rings. Oil consumption was high. Finally they consulted a Sun Oil Engineer, who recommended that they try Solnus Oils.

Trouble took a holiday when the change to Solnus Oils was made. With no mechanical changes in the engines, they ran for six months on Solnus Oils without any trouble. Then they were shut down for a routine check-up . . . disclosing almost complete absence of carbon and freedom from their old ring trouble. In addition, oil consumption was cut 20%.

Full speed ahead is now the order of the day in this plant, with no production delays due to forced power shutdowns. Can you say the same for your plant? Then why not investigate Solnus Oils . . . the oils that are especially made for today's heavy loads. They are low in carbon content, neutral in acidity, wholly distilled and durable. Consult a Sun Doctor of Industry today. Write . . .

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SUNOCO

SUN INDUSTRIAL PRODUCTS *HELPING INDUSTRY HELP AMERIC*

Navy Boilers

(*Continued from page* 90)

each produce 35,000 lb per hr of 190 psig steam at an efficiency of 60 per cent.

The boilers operate under induced draft produced by twin fan Thermix stacks, consisting of two double suction fans discharging into one stack. The outline of one set of boilers is shown in Fig. 2. The stack is a venturi type 55 ft tall and 8 ft wide at the top. The draft is controlled by an unbalanced vane damper in the fan discharge and a multi-vane balanced butterfly damper in the fan suction.

The eleven burners burn either gas or oil. Gas flowing through a jet mixer sucks in the primary air at the venturi throat. Therefore, combustion takes place close to the burner outlet where the secondary air is mixed with the primary charge. The alternate fuels, fuel oil or plant wastes, are fed under pressure and atomized with steam.

Water level in the steam drum is automatically controlled by a Swartwout regulator. Continuous blowdown is provided by a water collector pan near the middle of the steam drum connected to a nozzle on the drum. A pipe connects the drum to a flash drum and heat exchanger. The steam released is fed into the low-pressure steam system and the hot water heats the raw water feed to the water treating system. The mud-drum blowdown valves are used to remove sludge intermittently. The steam pressure in the main header actuates a gas pressure regulator on the natural gas header.

Electricity As An Aid In Wartime Industry

One of the most interesting sessions at the AIEE winter meeting in New York was the Conference on Industrial Power Applications. It was at this conference that Mr. Tracht of the Pennsylvania Salt Mfg. Co. presented the following discussion. In it, he reviewed the part electricity is playing in the wartime activity of the large electro-chemical and heavy chemical industries

By J. W. TRACHT
Pennsylvania Salt Manufacturing Co.

INCREASED PRODUCTION in the plant with which the author is associated has been accomplished with a far less than proportionate increase in operating personnel. This is significant considering that the average ability of workmen during wartime is below standard due to the necessity of substituting unskilled workmen for experienced workmen who must be released to the armed services. The ability to replace skilled workmen so released was further complicated by the location of the plant in the Detroit metropolitan area where concentration of plants producing material has resulted in a manpower situation generally considered to be the most critical in the country.

One method of increasing production without simultaneously increasing personnel was in the conversion of several processes from batch to continuous operation. The increased wartime production justified these changes, which could not be justified under prewar rates of operation. The continuous operation of processes requires accurate control of the continuous flow of materials to the process. Manual control is of course out of the question at this time.

By utilizing electrically controlled feeders and continuous scales, each component going into the finished product can be controlled within close limits. Further, coordinating and interlocking these equipments can be ideally accomplished by electrical means, thereby providing both quality and quantity control of the finished product. In addition electrical equipment is available for the automatic analysis of the components or of the product at various stages in its manufacture. By grouping recording electrical instruments at one remote control point a single operator is able to exercise complete control over an entire process and be better informed as to its operation than if he were on the site of the equipment—a condition which would be impossible in some instances. The saving in manpower is self evident. Without the ingenuity of modern electrical instruments and controllers, plus their adaptability for remote location of recorders, continuous operation of processes in the above manner would not be possible.

Overall expansion of plant facilities requires additional high pressure steam generation. Installation space for the new unit did not lend itself to supervision by the existing operating personnel and it appeared that operation of the new unit would require separation of boiler room control, plus the employment of additional operators—a caliber of workman now not easily acquired.

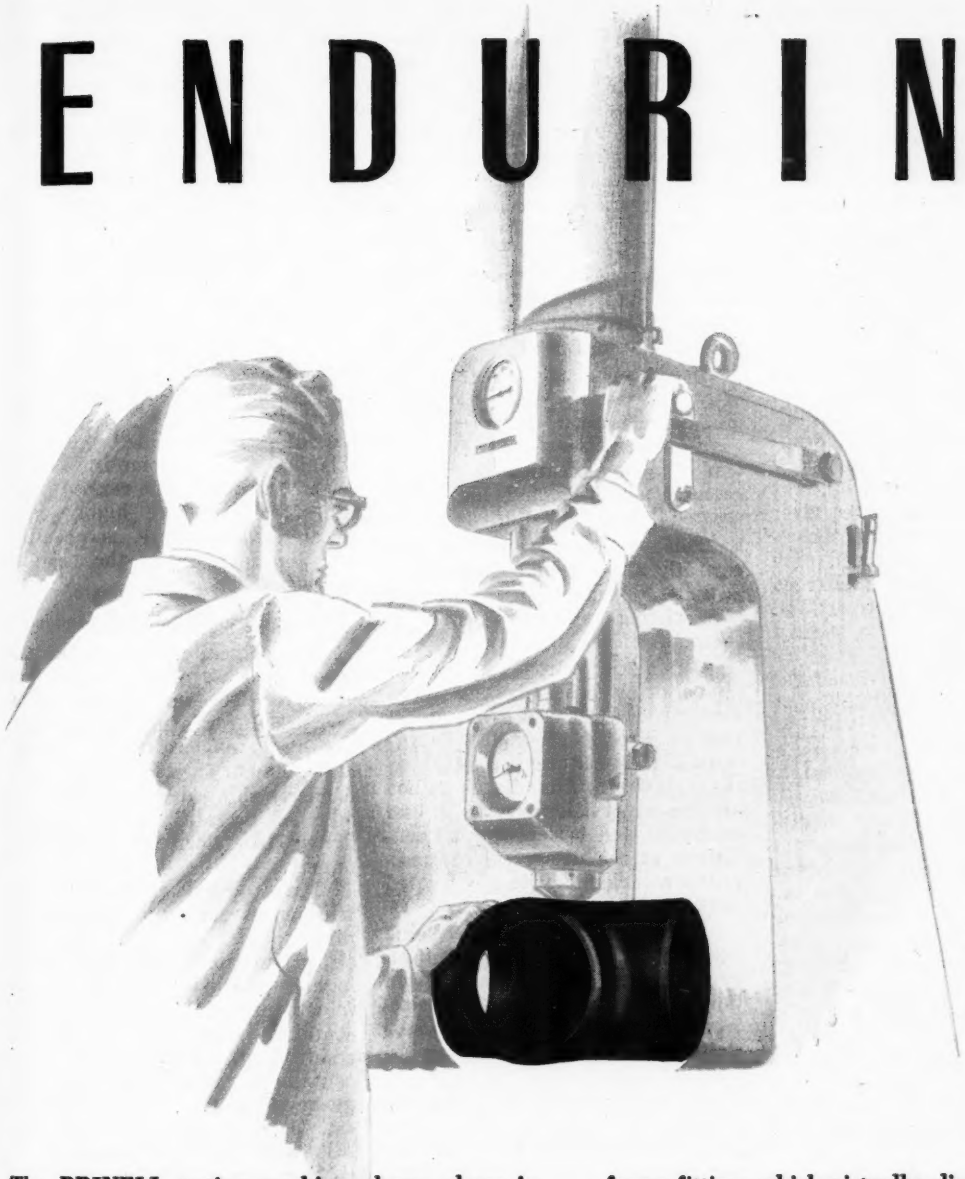
By equipping the new unit with automatic combustion control, which is largely electrical in nature, and by grouping all controls and instruments at the existing main control panel, successful operation has been accomplished without increasing operating personnel. Such operation is of course not without its hazards. To minimize these hazards the unit has been completely equipped with instruments plus visual and audible alarms remotely located at the main control panel, to permit the operators to constantly check water level, burner operation, etc. Photoelectric and other electronic equipments are ingeniously used for these purposes. Special design of a-c electric motor drives eliminated need for d-c power and facilitated installation of the unit.

Improved Production Control

The comments above upon increased production were chiefly concerned with processes in which obtaining increased production was the primary object. In other instances due to increased rigidity of product specifications, to obtain better production control, or to eliminate manhours of labor it was necessary to revise process installations. In these instances electrical equipment again played a most important role.

Caustic carryover into the condensate returned from the caustic evaporator room is to be avoided, or if it occurs, must be detected immediately that the concentration exceeds the allowable amount. High rates of operation plus necessity of employing some unskilled operators had increased the frequency of the occurrence of this accidental carryover. Manual an-

ENDURING



The BRINELL testing machine, shown above in Tube Turns' laboratories, scientifically determines the hardness, or wear resistance, of finished fittings.

Endurance is indispensable in welding fittings, for the destructive forces in piping — strain, pressure, vibration, corrosion and erosion — are more *highly concentrated at the fittings.*

Tube Turns' exclusive manufacturing process forges fittings which virtually eliminate premature wear, leakage, and maintenance throughout the life of piping. Systematic hardness tests *insure* the enduring qualities possessed by all Tube-Turn seamless welding fittings.

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Welding Fittings and Flanges

alysis of the discharge from each pan is slow, and high in labor cost.

Automatic equipment making use of conductivity cells was installed to check the composition of the discharge water from each pan at frequent intervals. These findings are electrically transmitted to a common electrical recording instrument located near the operator's position. In addition visual and audible alarms are automatically energized when a predetermined maximum concentration is exceeded.

During the initial operation of this system excess carryover was indicated in several instances although subsequent check of evaporator operation failed to show cause for this carryover. It was later discovered that the river water supply to the evaporator department at times contained high concentration of alkali discharged from a plant further upstream and it was this initial caustic content which had sounded the alarms. To compensate for this condition the incoming water and discharge water are separately given the usual test for presence of caustic and the characteristic colors so obtained are compared photoelectrically. This photoelectric equipment automatically subtracts the effect of the alkaline content of incoming water so that the impulses transmitted to the recording equipment are an accurate indication of carryover from our evaporators alone. The equipment used is fully automatic and has been proven in service. Advantages gained are improved operation, reduction of caustic losses and protection of purity of condensate—all with a decrease in operating personnel.

One of the electrolytic processes producing a product of increasing importance to the war effort is highly dependent upon constant conditions of operation in order to insure maximum production of a uniform, high quality product. One essential of this operation is that constant current be fed to the cells. Manual control of the conversion units failed to produce satisfactory results and consumed much labor time. Automatic voltage regulation using sensitive relays and electronic amplifiers was designed and installed. Operation of this simple, yet nearly foolproof, regulator has proven highly successful giving results superior to available commercial equipment and fully meeting the constant current requirements of the process.

Inter-plant communication in any industrial plant is an absolute must. This is and has been monopolized by electrical equipment with telephones leading the way. Plant expansions in recent years plus government restrictions on copper and other critical materials severely taxed telephone systems to the point where existing facilities would not handle the requirements of the plant expansions and in many cases additional telephone facilities could not be obtained.

In one instance the installation of a "wireless" electronic communication system utilizing existing lighting wires solved the problem of communication between a research engineer and his newly created laboratory staff.

This system has worked successfully and a similar installation is under consideration to augment the existing telephone system in the main office.

Automatic control of caustic temperatures when boiling down has proven successful. The stoker feed is directly controlled by the caustic temperature through electrical devices. Advantages gained are less supervision, saving in coal consumed and better working conditions as the disagreeable atmosphere coincident with overheated caustic is eliminated.

Electrical vibrators are being used extensively on hoppers, feeders, etc., to insure more uniform flow of dry materials. The electronic power supplied for these units has proven highly successful.

In one process utilizing expensive, intricate machinery, production and elimination of damage to equipment is directly a function of the operator's ability. As several units feed into one product handling equipment it was impossible to check the relative abilities of the operators on each unit. To overcome this difficulty automatic recording equipment was installed on each unit. Through use of selsyn devices the actual operations of the units are recorded on a remotely located instrument. This record checks each operator as to the quantity and quality of his production and has resulted in increased production of a superior product. Damage to equipment has been reduced due to installation of alarms as an integral part of the recording equipment.

Trends in the progress of the war dictated severe stiffening of the specifications on a product being supplied to the Chemical Warfare Service. Analysis of means by which these new specifications could be met clearly indicated that close control of the process, of an order never before attempted on this product, would be required. By means of close electrical control of the feed of dry constituents plus continuous analysis of composition, and control of quantity of gaseous constituents by means of special equipment, whose operation is essentially electrical in nature, the job was successfully accomplished. Further, by means of electrical recording instruments, control of this process is accomplished at a remote location. The revised process, which is more highly complicated than before, is operated with no increase in the original operating personnel.

Packaging and Material Handling

The critical nature of the national steel supply dictated that available stocks and production be earmarked for armament production at the expense of the packaging industry. Many products formerly shipped only in steel are now, of necessity, being shipped in wooden, fiber or paper containers.

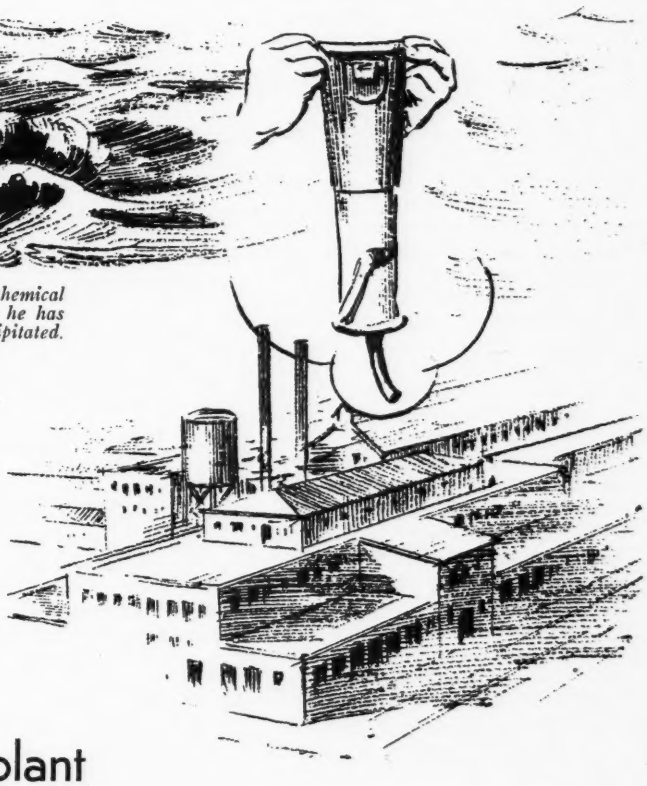
Many chemical products are vibrated as packed to reduce shipping space. Air operated, long stroke vibrators which had proven highly adequate for steel containers proved too violent for the containers of substitute materials, resulting in actual damage to the containers. Electrical high frequency, short stroke vibrators satisfactorily solved the problem. No delay was experienced in obtaining power sources for these vibrators as electronic power units were available on short delivery—in direct contrast to the long delivery on 15 cycle motor-generator sets previously employed.

Increased production together with the labor shortage required many changes in material handling methods. Necessary substitution of female help brought additional handling problems due to restrictions on their lifting capacity. Employment of power trucks has been highly successful. Electrically powered trucks have been favored because of quiet operation, lack of fumes which are disagreeable to workers and contaminate certain products, and because their operation is less hazardous in certain chemical processes.

SCIENTIFIC WATER CONDITIONING

cheats thirst of its terrors for men downed at sea . . .

Today the man forced down at sea simply drops a chemical "pill" into a plastic bag full of sea water. In 20 minutes he has a pint of clear water, from which the salt has been precipitated. Thirst is checked before it can start!



SCIENTIFIC WATER CONDITIONING

also checks trouble before it can start

in the modern industrial plant

WHEN the control of water conditioning in your plant is taken over by Bird-Archer it means far MORE than simply a routine analysis and a general recommendation. For you know that the generation of steam and its feed water problem is a many-sided affair with many different factors affecting it. Bird-Archer Service is truly a *scientific* Service because it includes the correlated work of (1) CHEMISTS (for analysis and conditioning treatments)—(2) CHEMICAL ENGINEERS (for the study of related processing problems)— and (3) MECHANICAL ENGINEERS (for practical power plant operation). Thus, trouble is checked from *every* angle. And the correct answer, based upon a COMPLETE study of all related conditions in YOUR plant, is obtained. *Please feel free to consult us for preliminary discussion, without obligation on your part.*

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The Winter Meeting of the AIEE

(*Continued from Page* 87)

facture may be carried out by either of two methods—the sintering process or casting. The first is usually employed to produce relatively small magnets sometimes found ideal for damping magnets and the like. The latter process is used for the production of the majority of alnico magnets.

The ideal magnet from the standpoint of the instrument designer would be one having high coercive force, residual induction and available energy, and which had good machining and fabricating qualities. An approach to this ideal has been made in the cobalt-molybdenum-iron alloys more commonly known as "comol." Comol, whose typical composition is 12 per cent cobalt, 17 per cent molybdenum, balance iron, contains a minimum of the critical metals; it can be easily cast, and when properly heat treated, can be readily drilled, milled and machined. As a result, accurate dimensions permit the degree of precision which is required to fully utilize this material in instrument magnets.

A coercive force of about 245 is obtained as compared with 210 for 36 per cent cobalt with a residual induction of 10,300, higher than either 36 per cent cobalt or alnico II, and a maximum energy value of 1,100,000 as compared with 930,000 for 36 per cent cobalt and 1,650,000 for alnico II.

A magnet of the comol type containing appreciably lower percentage of the critical elements has been utilized in instrument application as the permanent magnet in a new "thin" line of direct current and radio frequency G-E small panel permanent magnet-moving coil type instruments.

Fusing Practices on Distribution Systems

Of interest to utility men was a paper presented at the session on Transmission and Protective Devices on Tuesday, January 25, on fusing practices on distribution systems. This paper, presented by J. S. Parsons and J. M. Wallace both of Westinghouse Electric & Mfg. Co., pointed out that there seem to be almost as many fusing practices as there are operating companies. To determine present fusing practice in this country, a questionnaire was submitted to some 200 operating companies and replies were received from 168, indicating a real interest in this subject. The data presented in Messrs. Parsons' and Wallace's paper applied only to systems operating below 5 kv and was obtained from companies located in all parts of the country. It was revealed that 85 per cent of the companies use cutouts for line sectionalizing. Of these, 54 per cent use them on main feeders, 76 per cent use them on 3-phase branch feeders and 83 per cent use them on single phase laterals. The repeating cutout is most popular on the main feeders where 50 per cent are of this type, as contrasted with 41 per cent on the 3-phase branches and 37.5 per cent on the single phase laterals. About 70 per cent of the cutouts used for line sectionalizing, regardless of their location, are of the enclosed indicating type. Beyond the agreement that line sectionalizing is desirable, however, there is little uniformity of practice.

Circuit Breakers

New developments in the circuit breaker field were discussed in a number of papers presented at the circuit breaker session on Tuesday afternoon, January 25. It was at this session that E. W. Boehne of the General Electric Co.'s Switchgear Engineering Division presented his paper on "The Geometry of Arc Interruption." In this paper, Mr. Boehne described a method of determining the interrelation of recovery voltage, arc current, and arc resistance variations. The paper dealt primarily with zero current phenomena.

During the microsecond period in which an interrupter is performing the act of changing from a conductor to an insulator, Mr. Boehne explained, the current, voltage and arc resistance undergo variations which materially affect the performance characteristics of the interrupter. The nature of these variations depends upon the medium of interruption, design features of the interrupter, and the constants of the current and recovery voltage circuits. Modern power interrupters employing air pressure variations in the current zero region of an entirely different type from that observed in the liquid interrupters.

Interrupters which exhibit large arc voltages over the entire arcing period experience reduced recovery voltage oscillations and have the additional advantage of operating in a region which permits the current to be diverted and approach zero at a rate slower than normal.

Conversely, interrupters which develop low arc voltages are, in general, capable of producing greater than normal rates of change of current in the current zero region. Hence, under conditions of small inductive currents in circuits of high natural frequencies, this action leads to overvoltage conditions which must be considered in their application.

The rapidly varying resistances within the interrupter during the process of interruption have always presented obstacles to the analyst. In reapproaching this problem on the basis of an orderly, yet practical, variation of circuit current in the region of current zero and allowing the parameter of resistance to become secondary, the problem reduces to one of linear constants and can be solved by standard methods.

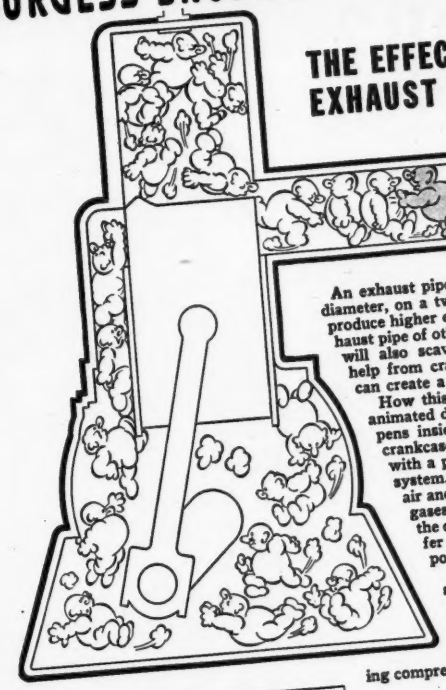
Mr. Boehne's paper presented such a treatment. It is generalized in such a way as to include all practical types of current zero phenomena generally encountered. Recovery voltage characteristics are literally fabricated from "standard building blocks" of which relatively few are required. The method is flexible enough to be applied to any assumed current variation in the region of current zero. The analysis is presented in terms of the accepted nomenclature of circuit theory. The operational attack is used.

Another interesting paper at the circuit breaker session was the paper by R. C. Dickinson of Westinghouse Electric & Mfg. Co. describing a 500,000 kva, 7.5 kv air circuit breaker for steel mill service. The author pointed out that a breaker of this capacity and voltage rating had long been regarded as a desirable goal. Recent developments in magnetic type air circuit breakers have indicated the economic feasibility of similar designs for ratings higher than previously attained. The development of this new breaker proved this contention. Laboratory tests show that this most recent breaker is well suited to the operating conditions of steel mills and equivalent service and that it has ample short-circuit interrupting capacity for use in large power concentrations at 6600 or 6900 v.

The foregoing, necessarily brief report does not attempt to present a picture of this meeting as a whole but it will give the reader some idea of its scope and wide range of interest. A number of the papers will be abstracted in near future issues.

BURGESS SNUBBER BULLETIN on Diesel Exhaust Noise Control

THE EFFECT OF PROPER EXHAUST DIMENSIONS



An exhaust pipe of the correct length and diameter, on a two-cycle Diesel engine, will produce higher engine efficiency than an exhaust pipe of other dimensions. Such a pipe will also scavenge the cylinder without help from crankcase air pressure, and it can create a super-charging effect.

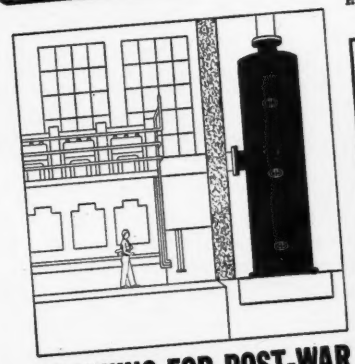
How this is done can be seen in the animated diagram. It shows what happens inside a cylinder of a two-cycle crankcase scavenged Diesel engine with a properly dimensioned exhaust system. The white men represent clean air and the dark men are the burned gases. The piston is starting up on the compression stroke. The transfer port is closed and the exhaust port is still slightly open.

Burned gases, which can be seen as the little dark men in the exhaust pipe, escaped through the exhaust port during the preceding downstroke, while air in the crankcase was being compressed to about five pounds gauge pressure. A negative pressure (partial vacuum) thus produced in the cylinder by the outrush of burned gases caused the air in the crankcase to scavenge the cylinder and part of the exhaust system. With the exhaust pipe of the correct dimensions so that it is properly related to the particular engine, the pull of the vacuum alone is sufficient to fill the cylinder with fresh air from the crankcase without any help, provided the air from the atmosphere can flow into the crankcase freely.

This scavenging action continues until the piston reaches the position shown in the diagram where it closes the transfer port, pinching off the fresh air from the crankcase.

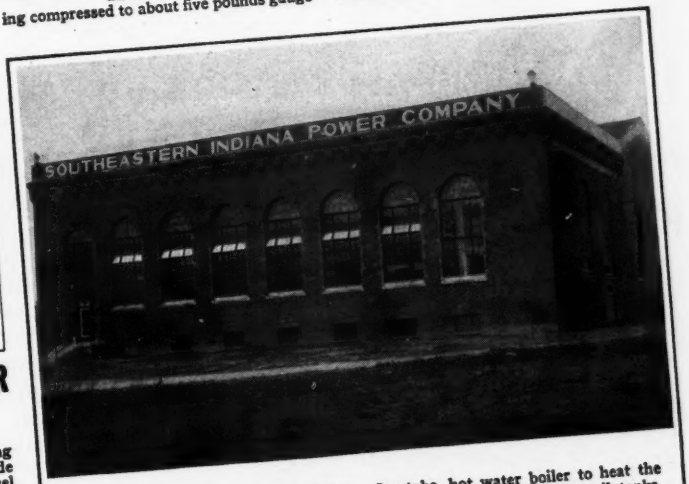
Fresh air flows out the exhaust port until the pressure in the cylinder is below atmospheric. Then due to the pressure differential, some of the fresh air in the exhaust system is "rammed" back into the firing chamber as the rising piston closes the exhaust port.

The important point here is that with a properly adjusted exhaust system, the last of the air pushed back into the cylinder is fresh and clean, and therefore assures good combustion. This reverse flow actually produces a super-charging effect. The volumetric efficiency of the engine rises above the efficiency obtained when the exhaust pipe is of such a length that clean air and exhaust gases race back and forth through the exhaust port while it is still open. Under the latter condition, burned gases may be forced back into the cylinder and cause poor combustion.



PLANNING FOR POST-WAR POWER PLANTS

One of the essentials of good planning for post-war power plants is to provide trouble-free exhaust systems for Diesel engines. While there are several ways to install Burgess Diesel Exhaust Snubbers, the method illustrated here is the simplest. The exhaust pipe from the manifold near the top of the engine is carried straight out to a side inlet Snubber. No supporting brackets are needed with this type of Snubber, since its base is fitted with a flange which can be bolted to the foundation. This Snubber will operate with equal high efficiency whether it is close to or far away from the engine.



One of the outstanding features of the Southeastern Indiana Power Company Plant at Rushville, Indiana, is the Burgess combination exhaust Snubbers and waste heat boilers. The Snubbers prevent the annoying exhaust noises from disturbing nearby residents. The boiler section of the Snubbers acts as a fire tube, hot water boiler to heat the various fuel and lubricating oil tanks, as well as the office and locker room, and provides hot water for showers and lavatories. Another economy feature is the heating of the plant building with hot air drawn from around the metal jackets of the Snubber bodies.

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HOW MUCH DOES A POUND OF STEAM COST YOU?

PLAN NOW FOR POST WAR COMPETITIVE CONDITIONS

THERE'S many an "if" and "but" involved in any plant manager's plans for a safe return to the production of civilian goods. Two things, however, are certain: post-war competition will be severe, and the man who can produce the best quality product at the lowest cost will be the one who will climb to the top in the scramble!

STEAM is an important "raw material" item on any plant's production cost sheet, yet its "price" varies greatly, depending upon the efficiency of the individual boiler plant. *How much does a pound of steam cost you?* In a competitive struggle lower steam costs may well make all the difference between a healthy profit and no profit at all.

TODAY many factories and commercial buildings are already enjoying low-cost steam production with TODD burners. Investigate *your* combustion equipment *now*—compile specifications for improvements that will lower over-all manufacturing costs. Be ready to take advantage of the first opportunity to secure TODD burners. TODD engineers will be glad to make an impartial survey of your boiler plant!

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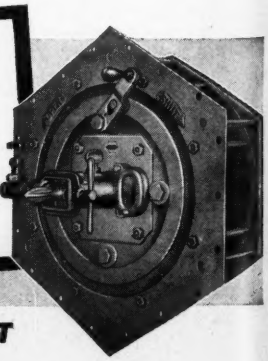


ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

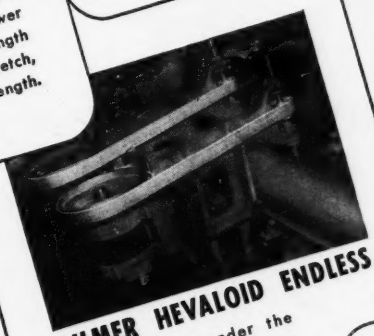
SPEED PRODUCTION WITH Gilmer BELTS

Gilmer makes complete line of V-Belts, Endless or Non-endless Flat Belts, and a full range of highly specialized belts for use wherever standard belts are unsuited. For further information about the various Gilmer Belts and their plant applications, write for a FREE copy of the Gilmer Belt Catalogue.

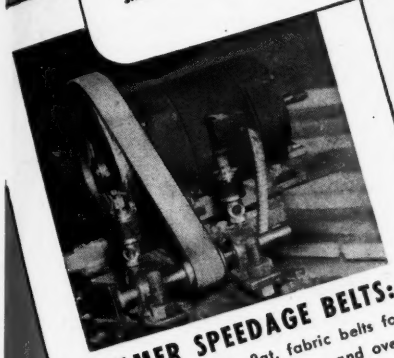
GILMER V-BELTS: Space-saving, silent, shock-absorbing belts, built to lock in the grooves with a non-slip grip. Made in standard and special sizes.

GILMER KABLE KORD BELTS: Rubber fabric and tough continuous cord construction give you a contactor and power belt in one. Exceptional grip and strength combine in these flat belts with low stretch, small slippage and extra tensile strength.

GILMER ENDLESS PLANER BELTS: A typical special purpose belt of endless cord construction for planer and gang-saw drives.



GILMER HEVALOID ENDLESS BELTS: Made under the Hevaloid patent with Neoprene compound that provides high coefficient of friction. For precision work at top speed of 9000 f.p.m. Resists oil, heat, stretch and slippage.



GILMER SPEEDAGE BELTS: Very light, lapless, flat, fabric belts for high speeds to 10,000 f.p.m. and over. Assures chatterfree production.

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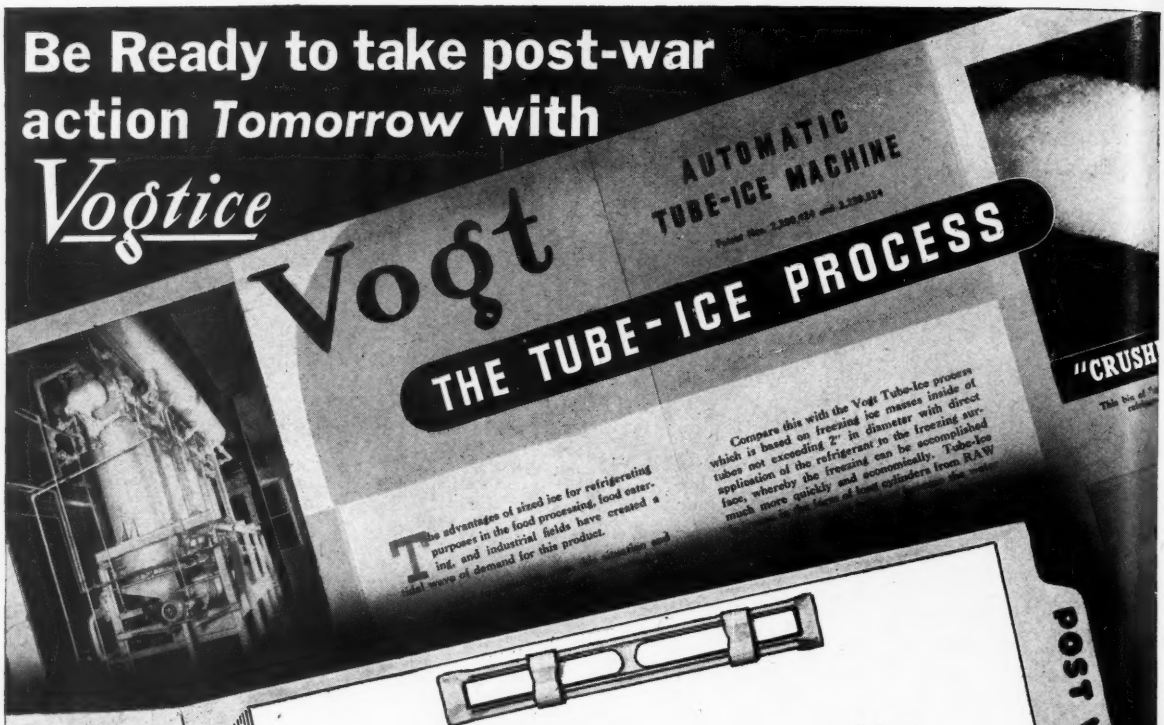
L. H. GILMER COMPANY, Tacony, Philadelphia 35, Pa.

The Oldest Firm of Rubber Fabric Belt Specialists

Be Ready to take post-war action *Tomorrow* with *Vogtice*


Vogt
AUTOMATIC
TUBE-ICE MACHINE
THE TUBE-ICE PROCESS
The advantages of sized ice for refrigerating purposes in the food processing, food catering, and industrial fields have created a
Compare this with the Vogt Tube-Ice process which is based on freezing ice masses inside of tubes not exceeding 2" in diameter with direct application of the refrigerant to the freezing surface, whereby the freezing can be accomplished
"CRUSH

Write for BULLETIN TI-2 for the complete *Vogtice* story

POST WAR PLANS

MEMO

Install Vogt Tube Ice Machine.

This will:

1. Require only 64 sq. ft. for new 30 ton unit against 652 sq. ft. of present ice tank of same capacity. Won't need new building.
2. Eliminate special equipment - no crushers or cubers needed.
3. Definitely reduce our labor cost.
4. Make clear, hard ice in "crushed" or "cylinder" form by simple adjustment of cutter.
5. Help cash in on new, profitable business because Vogtice is a new type of sized ice and costs less per ton.

This is a natural

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TO MEET YOUR SERVICE NEEDS

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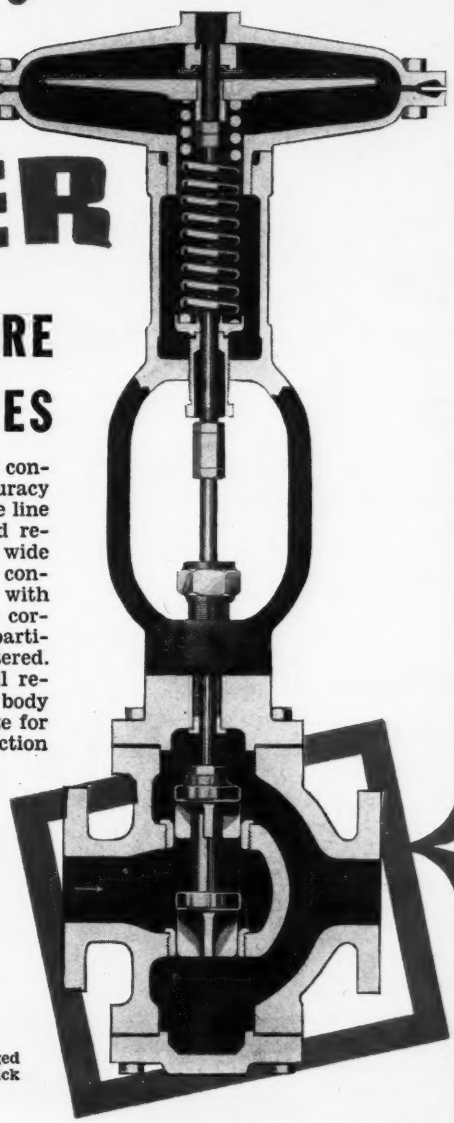
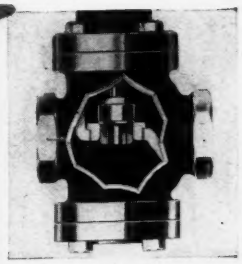
Designed to automatically maintain constant reduced pressures with accuracy and dependability—Fisher's complete line of spring controlled direct operated reducing valves is available with a wide variety of body and inner valve construction and standard topwork with diaphragm and spring combination correctly sized to exactly meet the particular operating conditions encountered. Fisher engineers gladly assume full responsibility for selecting the proper body and inner valve construction and size for your requirements basing that selection on the specific pressures, pressure drop, and capacity to be handled.

Illustrated are a few of the many bronze, high-tensile iron, and electric cast steel bodies that are available with a wide assortment of inner valves to meet every operating condition.

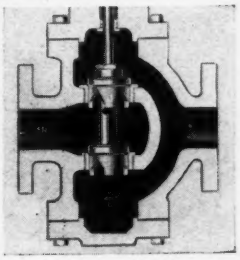
Write for Bulletin C for complete specifications on all types of Fisher Pressure Reducing Valves.



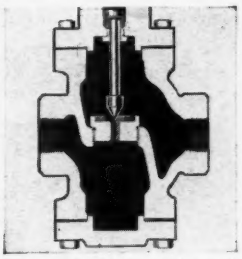
Type 57 with standard flanged globe double port body and quick opening type inner valve.



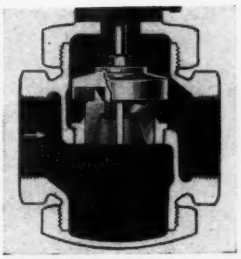
Screwed globe single port body with quick opening inner valve.



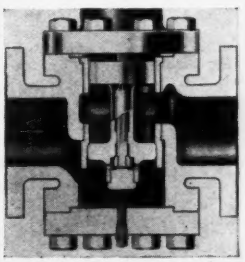
Flanged globe double port body with V-Port type inner valve.



Screwed globe single port body with needle point inner valve.



Reversible bronze single port body with composition disc inner valve.



Flanged globe single port body with piston balanced and internal pilot operated inner valve.

Our increased manufacturing facilities, plus new and improved methods, resulting from our all out War Effort have greatly stepped up the production of Fisher Automatic Controllers. Consequently, we are now in a better position to invite your inquiries on general industrial automatic control requirements.

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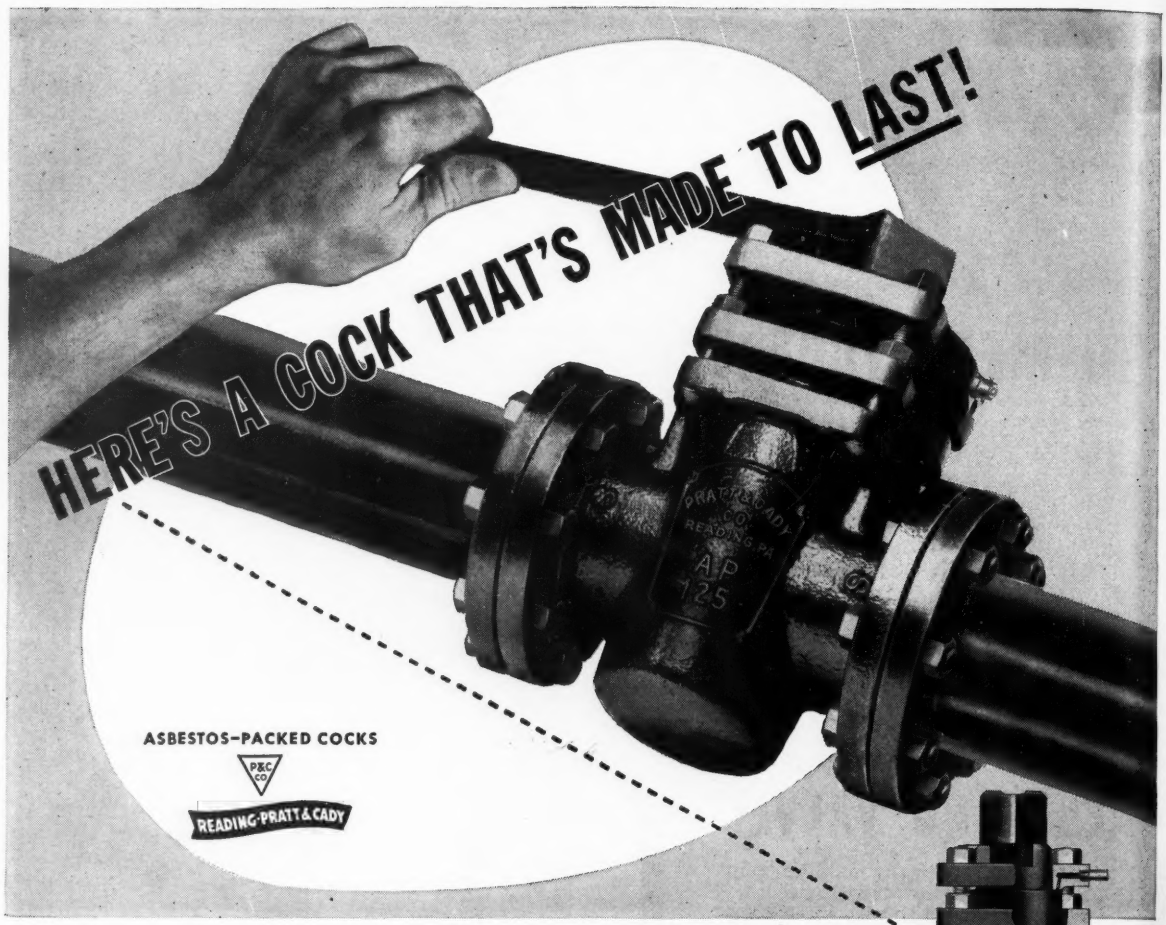


The Asbestos Packed Cock is a READING-PRATT & CADY "original"—made to hold a constant, tight seal and give you real service.

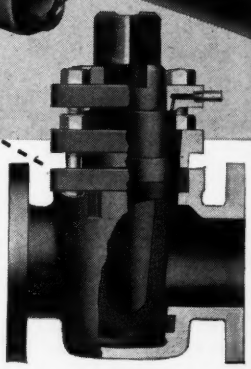
How?..

1. Because of its well-engineered, simple plug, bolted cap design.
2. Because of its asbestos packed U-grooves that:
   a. Provide a tight seal.
   b. Wipe from seating surfaces the foreign matter that other cocks grind in.
   c. Minimize normal friction.
   d. Provide a cushion to absorb the expansion differential between metal of the plug and body.
   e. Can be repacked at the factory, restoring the cocks to good-as-new condition.
3. Because it's made of materials that stand up under services for which they are recommended.
4. The holding down gland design illustrated results in much easier operation and much longer life.

Where?.. for shut-off service on lines that carry:

1. Solids in suspension • 2. Viscous fluids • 3. Oils • 4. Acids and alkalis • 5. Steam, for boiler blow-off

Paper mills, steel mills, packing houses; soap, dye stuffs and by-products plants use this cock in many of their process lines—wherever Globe, Angle or Gate Valves fail or ground cocks prove unsatisfactory. The petroleum industry uses it on gas wells, pipe lines, refinery lines, general "filling" lines, etc. Currently made in cast iron, bronze and cast steel—according to the needs of the service.



Cross section shows the location of the U-groove. Made in either single gland or double gland design. In the double gland design (illustrated) the top gland holds the plug at a pre-determined, constant pressure while the second gland independently compresses gland packing.

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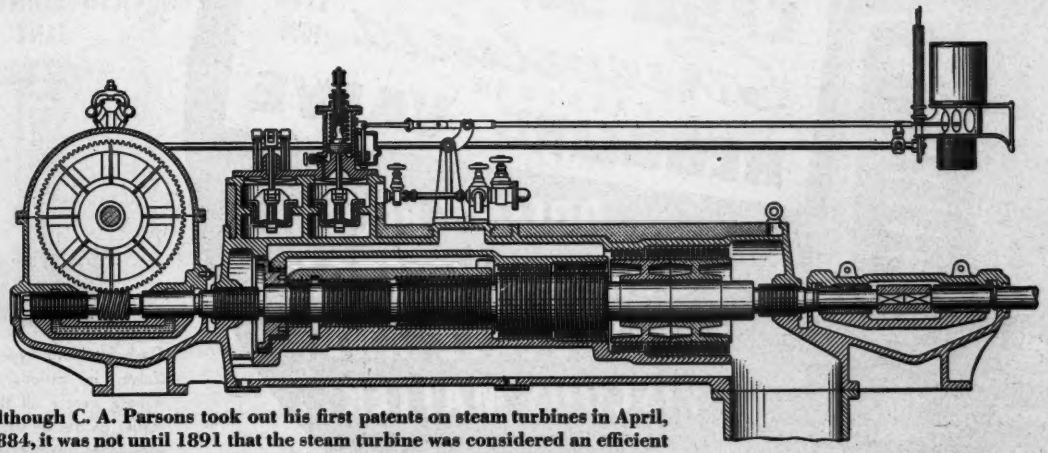
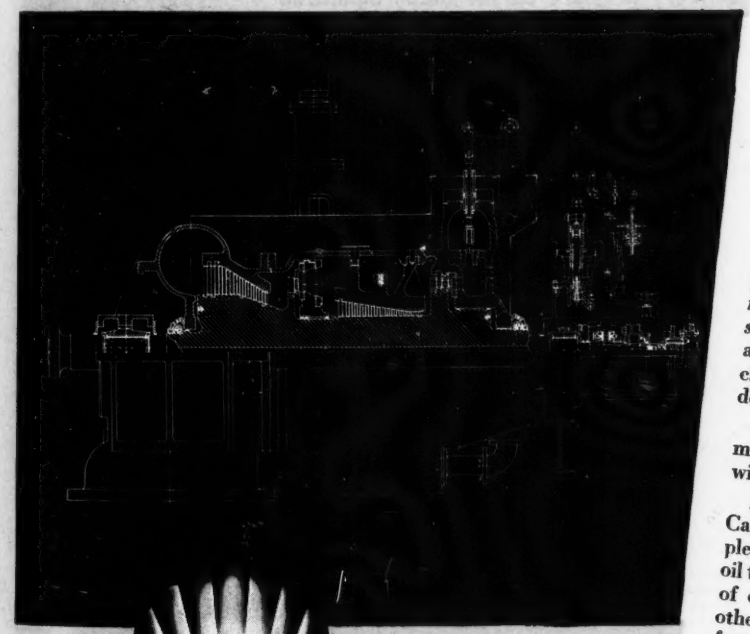
In 1891 a one-job oil was good enough...



Although C. A. Parsons took out his first patents on steam turbines in April, 1884, it was not until 1891 that the steam turbine was considered an efficient machine. Shown above is a cross-section of the general arrangement of an early Parsons' steam turbine that ran at relatively low pressures and temperatures. All that was required of a turbine oil then was that it lubricate.

The compactness and high operating efficiency of the modern steam turbine calls for a lubricant that must do more than just lubricate. A turbine oil today must also prevent rust, have superior oxidation stability.



BUT TODAY'S TURBINES NEED THIS 2-JOB TURBINE OIL!

1. That prevents rust

2. That has superior oxidation stability

THE MODERN, high-speed turbines of today with their closer clearances, high-steam temperatures and pressures, need more than a good lubricant. They need an oil that *prevents rust* as well as one that has superior *oxidation stability*. One that is suitable for use in governors as well as bearings. Shell Turbo Oil has both characteristics, because Shell Turbo Oil was designed from the start as a 100% turbine oil.

Because your turbines may be humming merrily along right now is no guarantee they will continue to do so.

Be sure your turbine oil is doing both jobs. Call in the Shell man. Let him show you samples of Shell Turbo Oil . . . the 2-job turbine oil that right now is performing in the turbines of our battleships, destroyers, cruisers and other units of our fleets . . . doing a job that is far tougher than any it will be required to do on land. In fact, Shell Turbo Oil was the first of its type to be approved as meeting rigid U. S. Navy specifications.

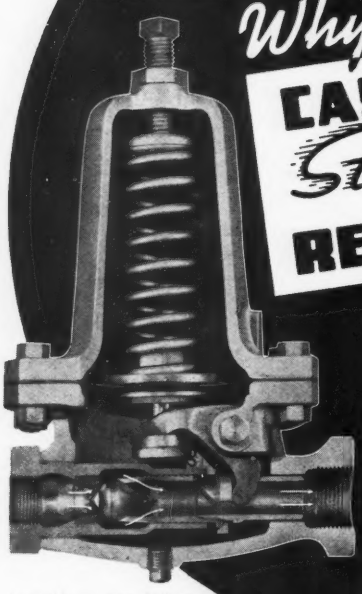
If you are not close to a Shell office, write Shell Oil Company, Inc., 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California.

SHELL

TURBO OIL

Why the CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000

. . . . DOESN'T BECOME GUMMED UP FROM DIRT-SCALE AND VISCOUS MATTER . .



Available in sizes ¼" to 2". Each size with expanded outlet if desired.

● There are no complicated inside works in the "1000" valve. As a matter of fact there is only the one vital moving part — the seat piston. There are no restricted passages, no small ports, no aggregation of close fits. It's streamlined all of the way.

The seat piston is opened in a positive manner by the force of the initial pressure and is closed in an equally positive manner by the force exerted by the delivery pressure on the diaphragm. The seat piston is tied to the diaphragm by the rocker arm so that when the diaphragm moves it must move too.

Thus, the positive moving valve arrangement in STREAMLINED housing, with its continuous-duty performance insures against trouble from gumming up, thereby minimizing maintenance.

PERFORMANCE RESULTS FROM *Streamlined Flow*

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

Write for Bulletin "1000" which gives details on the performance of this "Streamlined" 1000 valve and its benefits.

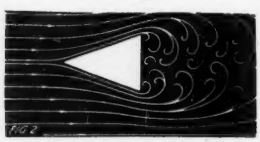
How Streamline Design Works

● Flow has been streamlined for straight flow into the delivery passage and jet. See FIG. 1. The fluid

FIG.-1

flows smoothly around this valve with no back eddies to cause turbulence, See FIG. 2, on the downstream side of its trailing edge. In a reducing valve all the pressure drop or work of pressure reduction should occur at one place, namely where the valve throttles flow, and not on the downstream side of the valve. Where you have downstream turbulence, See FIG. 2, the greatest amount of turbulence with resultant greatest pressure drop will occur when you want maximum flow and therefore want least pressure drop—if the delivery pressure is to be maintained. With

FIG.-2

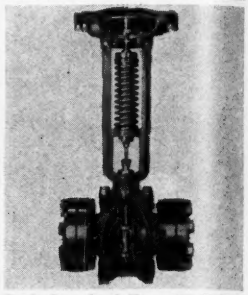


Streamlined Flow, See FIG. 1, you get maximum capacity, plus close delivery pressure control.

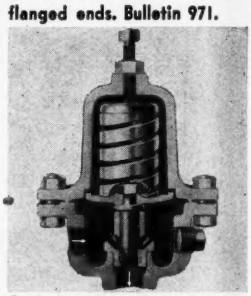
CASH STANDARD CONTROLS . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

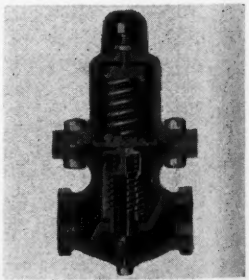
OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 33 Relief Valve; in various metals to handle nearly all fluids. Has Roller guides on valve spindle; also roller bearing to take care of spring torsion. Sizes ½" to 3" screwed ends; 1" to 12" flanged ends. Bulletin 971.



Cash Standard Type Q Relief Valve has side inlet, bottom outlet. Popular for pump bypass use. Sizes ½" to 2" screwed ends. Relief pressures up to 350 lbs., temperatures up to 500°F. Bulletin 943.



Cash Standard Type 4190 Valve for relief (bypass) use; holds constant valve inlet pressure regardless of changes in load or outlet pressure. Multiport—large capacity. Iron or bronze bodies; iron or bronze trim. Sizes ½" to 2" screwed ends; 2" to 6" flanged ends. Bulletin 952.

"F & E" Stokers

FIRE 1006 BOILER HORSEPOWER AT HOFFMAN-LA ROCHE, INC.

Power must not fail in the plant of Hoffman-La Roche, Inc., Roche Park, Nutley, N. J., for in this plant are manufactured vital medicines and vitamins to help keep Americans healthy.

Four "F & E" Underfeed Stokers . . . 2 Series 70 Steam Ram Drive and 2 Series 60 Unit type, Electro-Hydraulic Ram Drive . . . have furnished dependable power for over two years, a major factor in the enormous and still expanding production of this plant. Normal rating of the four boilers totals 1006 H.P., total steam capacity of stokers 72,000 lbs. per hr. Ordinary run of nut and slack bituminous coal is used.

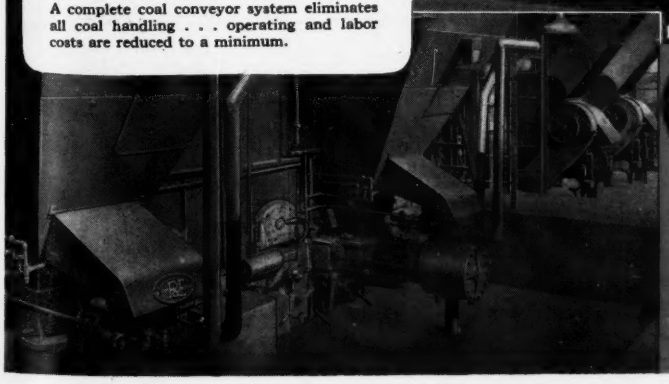
Hoffman-La Roche, Inc., is only one of many hundreds of production-minded companies who are experiencing the dependability and economy of "F & E" Underfeed Stokers. Is your company one of them?

All you need do to find out what "F & E" Stokers can do for you is to talk to your own consulting engineer or see the "F & E" representative in your territory.

Administration building of Hoffman-La Roche, Inc., Roche Park, Nutley, N. J.

View of boiler room. The two B & W stokers in the foreground are Series 70 Steam Ram Drive, installed under B & W Cross Drum, 303 H.P. boilers. The two stokers in the background are Series 60, Unit Type Electro-Hydraulic Steam Ram Drive, installed under 200 H.P. HRT boilers.

A complete coal conveyor system eliminates all coal handling . . . operating and labor costs are reduced to a minimum.



F&E STOKERS

for boilers producing from 1000 to 40,000 lbs. of steam per hour

are manufactured by

FLYNN & EMRICH CO.

Established 1842

HOLLIDAY & SARATOGA STS., BALTIMORE-2, MD.

Representatives in Principal Cities

REPRESENTATIVES WANTED in Virginia and the Carolinas
Attractive sales territories now open to aggressive individual or [illegible]. Contact manufacturer for details of franchise.

NINE FOOT TWO . . . SEAMLESS . . . TRUE

Another example of Taylor Forge "know-how" that means extra value in WeldELLS

Turning out a 110" O.D. SEAMLESS Steel Flange to rigid specifications of accuracy isn't exactly the easiest job in the world. But tough jobs are not unusual here at Taylor Forge. In fact, this one is quite typical of the kind that is so often assigned to us by engineers who feel we are a little better at it than any other organization.

For a good many years these "unusual" things have been the usual at Taylor Forge . . . doing things with hot metal that nobody else does . . . knowing just how to control its flow and form under pressure and impact.

And in the final analysis there is no better example of this than your old friends WeldELLS and other Taylor Forge welding fittings themselves. For while WeldELLS represent our regular line of welding fittings, they reflect forging operations that are *far* beyond the usual!

Check down the list of WeldELL features and you will see how true this is. Only Taylor Forge knowledge and methods could give you a fitting with tangents and selective distribution of metal in an extremely accurate, seamless forging! Add to this the features of WeldELLS which cut welding time and costs, and you have the fittings that . . . *"have everything"!*

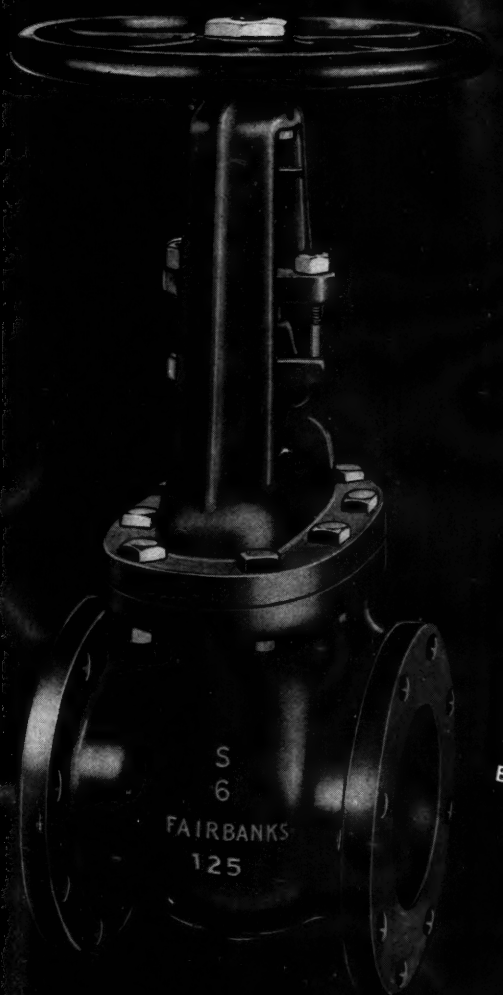
No other welding fittings combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

Fairbanks Valves



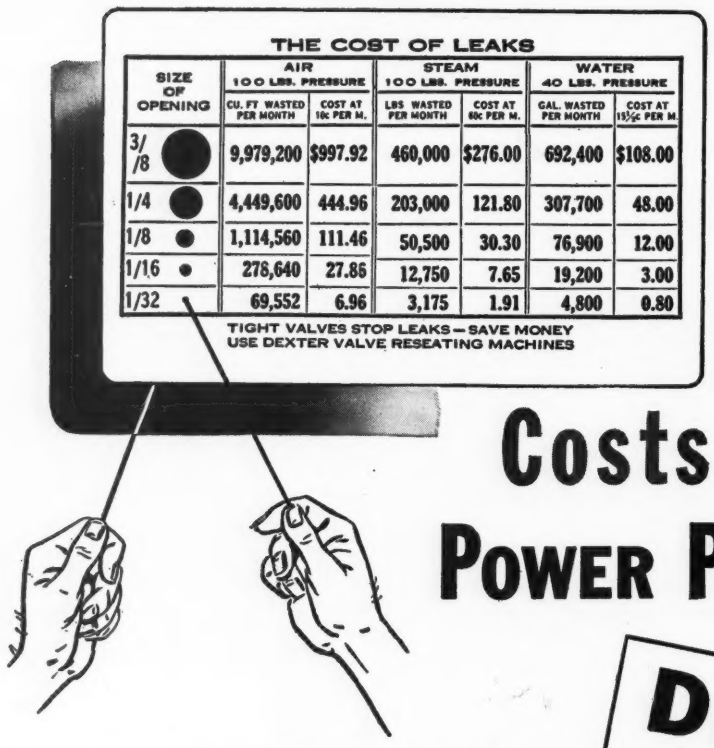
True to a Quality Tradition

Dependable performance, long life and low maintenance cost have won the respect and admiration of Fairbanks Valve users for more than half a century.

Fairbanks Valves are made of bronze and iron in types and sizes for practically every service.

Write for catalog No. 42 and name of our nearest distributor.

THE FAIRBANKS CO.
393 Lafayette St., New York 3, N. Y.
Boston, Mass. Pittsburgh, Pa.


THE COST OF LEAKS
SIZE OF OPENING
AIR 100 LBS. PRESSURE
CU. FT WASTED PER MONTH
COST AT 10c PER M.
STEAM 100 LBS. PRESSURE
LBS WASTED PER MONTH
COST AT 60c PER M.
WATER 40 LBS. PRESSURE
GAL. WASTED PER MONTH
COST AT 15½c PER M.
3/8 9,979,200 $997.92 460,000 $276.00 692,400 $108.00
1/4 4,449,600 444.96 203,000 121.80 307,700 48.00
1/8 1,114,560 111.46 50,500 30.30 76,900 12.00
1/16 278,640 27.85 12,750 7.65 19,200 3.00
1/32 69,552 6.96 3,175 1.91 4,800 0.80
TIGHT VALVES STOP LEAKS—SAVE MONEY
USE DEXTER VALVE RESEATING MACHINES

Wire Drawing Costs Money in Power Plant Valves

That small valve leak opening — the equivalent of a $\frac{1}{32}$-inch hole, for example — can cause big losses in steam, air or water; and in certain process lines a small leak may be really serious. Unless the leak is repaired promptly, it will grow in size until a complete overhaul or a new valve is needed.

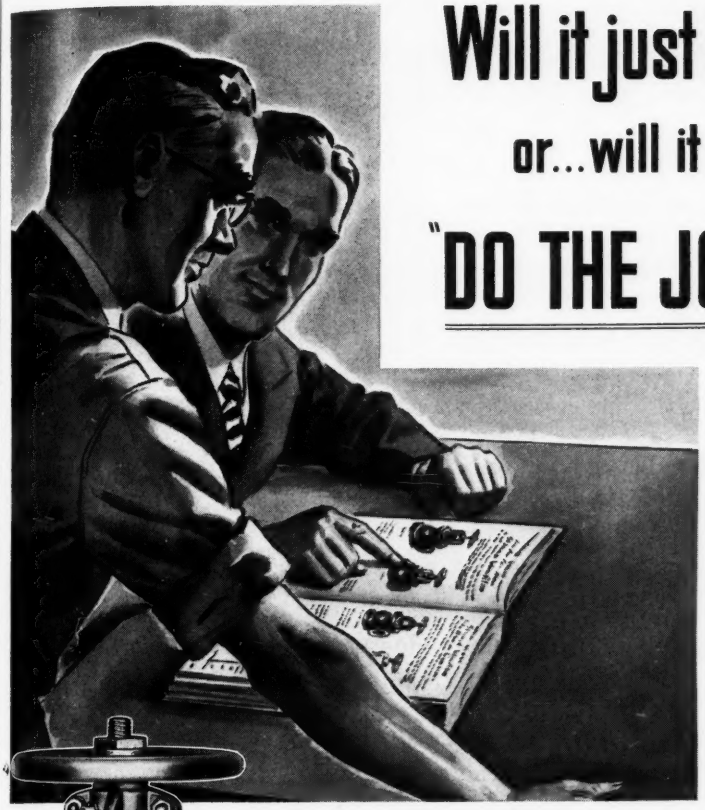
Reseat Early, the Low-Cost Dexter Way

The only sensible way to stop "wire drawing" and leak losses is to reseat the valve, in the early stages, right on the line, with Dexter Valve Reseating Equipment. No new parts will be needed, little time will be lost, and the labor cost will be negligible.

Tell us about your leaky valves. We'll tell you the Dexter equipment needed to stop your troubles — permanently.

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

Will it just "do," or... will it "DO THE JOB"



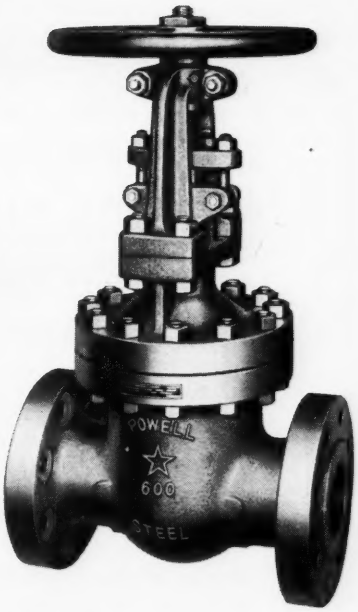


Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes, 1" to 24", incl.

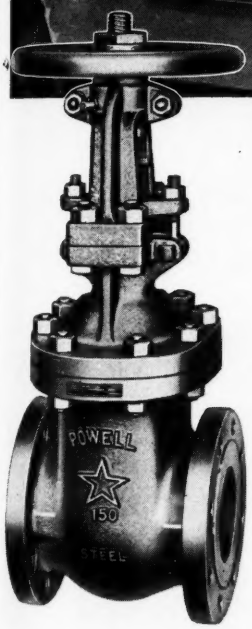


Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes, 1" to 24", incl.

"There is a valve that will *do*"—or "there *is* a POWELL Valve that will *do the job*"—what a vital difference in meaning.

But as long as you have POWELL Engineering at your service, you'll never have to make a valve "do" because POWELL not only has a complete line of standard valves as listed in our general catalog but—POWELL Engineering is ready at all times to offer *specialized* service.

Shown here are three of POWELL'S complete line of Steel Valves. These are especially suitable for controlling *steam* or *boiler feed* lines. POWELL Steel Valves are also available in both plain carbon molybdenum steel and highly alloyed steels for *special boiler feed* service.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

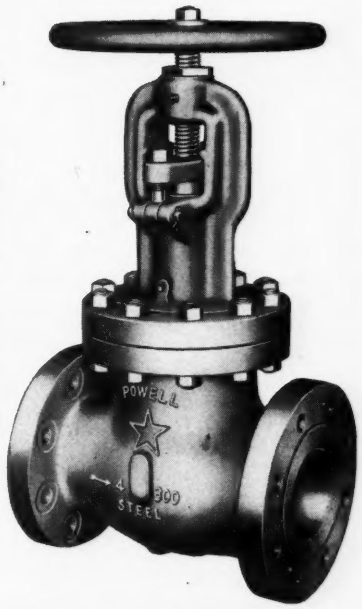
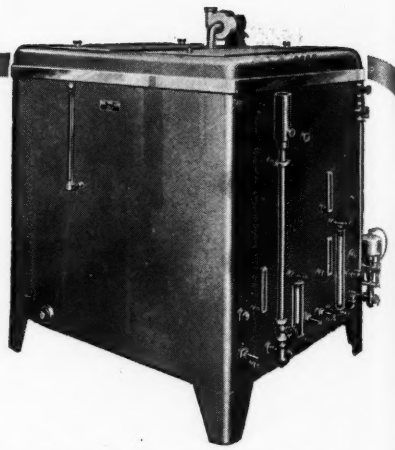


Fig. 3031—Class 300-pound Cast Steel Globe Valve, with flanged ends, outside screw rising stem, bolted flanged yoke. Sizes, 1" to 10", incl.

POWELL VALVES

HOW A BOWSER TURBINE OIL CONDITIONER *Saves Bearings, Oil, Time, Money* FOR A LEADING STEEL COMPANY



A BOWSER Turbine Oil Conditioning System, installed by a leading steel company, has been responsible for these outstanding operating improvements:

- Within ten days after installation, it reduced the acid number of the oil from .0561 to .021. (When the system was put in operation, the old oil was .2512, and the new oil added to meet the system's requirements was .02805. Note that, in ten days, the conditioner even lowered the acid reading below that of the *new* oil.)

- There was only one bearing failure, whereas previously frequent bearing changes were necessary. (The single failure, according to operating records, was due not to lubrication failure, but to impeller misalignment.)

- Only small amounts of make-up oil are added periodically. In several years of operation, it has never been necessary to dump the batch.

- Average oil temperatures in the reservoirs and turbines were reduced 51 degrees, from 185° F. to 134° F.

All of these factors add up to a major saving in time, labor and money. While this particular case history involved a worse-than-average acid condition, Bowser Oil Conditioning assures proportionate results . . . *and savings* . . . in virtually any turbine operation.

The Bowser engineering staff will be glad to consult with you about any lubrication problems. BOWSER, INC., Fort Wayne, Indiana.

Bowser Turbine Oil Conditioners serve all sizes of installations, up to the great utilities plants. They are equally adaptable to all types of steam turbine equipment, including turbo-generators, turbo-compressors, pumps, fans, blowers and other units.

In other phases of industry, Bowser equipment is also serving thousands of companies in the metering, dispensing, storing, filtering and distilling of liquids. Wherever liquids are handled, there's a need for something that Bowser makes.

BUY WAR BONDS

BOWSER ESTABLISHED 1885

LIQUID CONTROL SPECIALISTS SINCE 1885

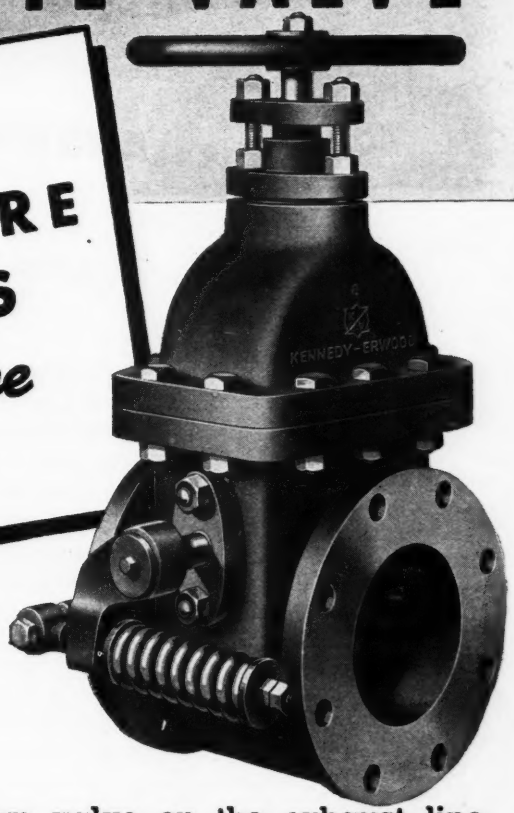
KENNEDY -ERWOOD

SWING GATE VALVE

Protects

LOW PRESSURE APPARATUS

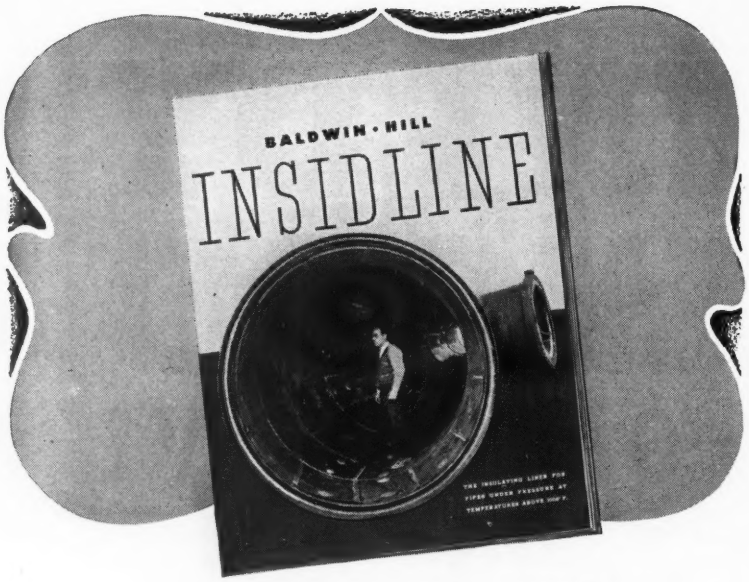
from excessive pressure



Combines the functions of a gate valve, check valve and relief valve in a single unit.

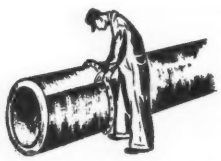
Used extensively as a non-return valve on the exhaust line between turbines or engines and condensers or heaters to protect low pressure casings and cylinders against building up of pressure which might cause failure and severe damage to equipment or injury to operatives. Folder on request, explains other applications as a back pressure valve, atmospheric relief valve or safety valve on pumps, compressors, etc.

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.



THE LOGICAL ANSWER

to High-Temperature, Pressure-Piping Problems



Insidline installations in pipe from 2" I.D. to 36" I.D. are made with a cartridge type of insulation that is built up first, and then drawn into the pipe.

In larger diameters from 36" up to over 100", a panel type of Insidline is built up on the inside of the pipe.

INSIDLINE, AN INTERNAL INSULATION, enables ordinary carbon-steel pipe, with its comparatively light weight and low cost, to stand up under conditions never before possible. Many new processes involve the piping of flue gases, steam, petroleum gases, hydrogen, and fluid catalysts at temperatures up to 1500° F., pressures up to 300 pounds, and velocities up to 500 feet per second. Insidline holds the temperature of the piping to 650° F. or below where it can be operated indefinitely at the usual stress allowances.

If you have a high-temperature piping problem today . . . or if you are contemplating new processes involving high temperatures for tomorrow, it will pay you to send for a copy of this new, free INSIDLINE booklet now. *Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, N. J.; Kalamazoo, Mich.; Huntington, Ind.*

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

Heat Absorption and Performance Factors of Twin Branch 2500-Psi Boiler

(*Continued from page* 71)

protection against excessive localized change in heat-absorption rates across the tube wall.

As a part of the final alterations of the unit, stud plates were applied to the upper 15 ft of primary-furnace-wall tubes[3] to provide protection of the pressure parts against this capricious behavior of slag in the hotter zones. A comparative pattern of tube-temperature distribution at the same location after installing stud plates is shown in Fig. 1, Right. It is apparent that the temperature differential between the outer tube surface and saturation is as great as for the slag-covered bare tube of Fig. 1, Left, indicating that normal heat-transfer rates are substantially equal for the two types of surface. However, there has been a consistent absence of sudden temperature changes as a result of greater permanency of the protective tube covering.

Slag Characteristics

Slag is without question the greatest single factor causing variation and disturbance in the performance of the absorbing surfaces. The extent and thickness of coverage are affected by composition of the coal ash, by segregation effects within the furnace, by excess air and the nature of the furnace atmosphere and, of course, by change in temperature of slag particles and gases in their passage through the unit.

Samples of slag, collected daily from the tap stream, have shown appreciable variations in fusing characteristics and in the state of oxidation of the iron content. Other samples collected from different portions of the unit show significant diversities of composition and fusing-temperature range. It is apparent that the effect of iron, which in its ferrous form acts as a dominant fluxing agent, is materially altered both by segregation of quantity and state of oxidation, in passage through the unit.

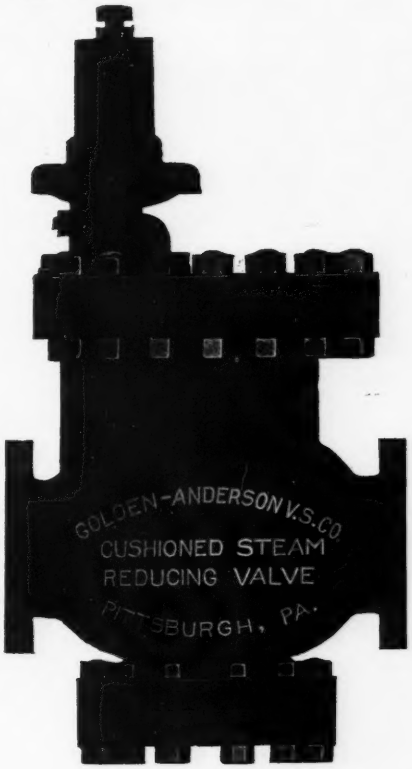
Final Alterations and Performance

The final alterations[3] which have permitted continuous base-load operation since November, 1942, consisted principally of reducing the amount of exposed surface in final superheater and in intermediate and final reheater sections and provision of retract-

[3]See POWER PLANT ENGINEERING, January, 1944, page 80.

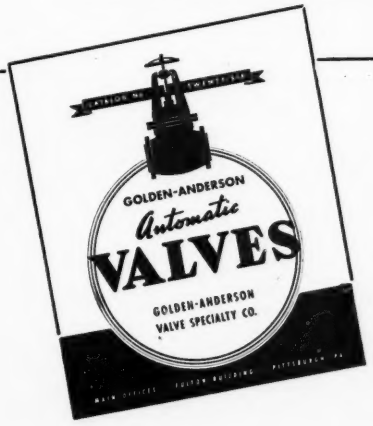
Specialty Valves

by GOLDEN-ANDERSON



STEAM PRESSURE REDUCING VALVE

● Adaptable to various intermittent and dead-end services this G-A Special-Service Valve insures uniform terminal pressure regardless of varying conditions. It is constructed Double-Extra-Heavy throughout and will efficiently handle 125 to 400 lbs. of saturated or superheated steam. Valve may be direct-controlled or operated by remote Pilot control. The Steam Pressure Reducing Valve is furnished in sizes ranging from 2½" to 12", with trim of Bronze, Monel Metal or Stainless Steel.



SEND TODAY FOR THIS CATALOG . . .
CONTAINS COMPLETE CONSTRUCTION AND APPLICATION DATA ON THESE G-A VALVES

Triple and Single Acting Non-Return Valves ● Throttle and Emergency Stop Valves ● Electric Emergency Trip Valves ● Steam Pressure Reducing Valves ● Water Pressure Reducing Valves ● Check and Relief Valves ● Altitude Control Valves, Single and Double Acting ● Float Control Valves ● Water Strainers ● Electric and Manual Water Service Valves ● Coke-Quenching Valves ● Standpipe Valves ● Solenoid Operated Valves.

GOLDEN-ANDERSON

VALVE SPECIALTY COMPANY

1300 FULTON BLDG., PITTSBURGH, PENNSYLVANIA

- Cadmium Plated Inside and Out
- High-Grade Woven Monel Wire Screen
- Readily Removed Steel Blow-Off Bushing
- Screen and Bushing Come Out Together—Go Back Together, Automatically Aligning
- For Steam Lines or Water, Oil and Other Fluids
- Reasonably Priced
- 6 Sizes from ½" to 2" for Pressures up to 600 lbs
- Many Thousands in Service
- Sold by Over 100 Mill Supply Houses

See Your Supply House or Send for Bulletin S-200

YARNALL-WARING COMPANY
114 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

able blowers in the second open pass.

A general survey of thermal-performance conditions existing throughout the unit is shown in Fig. 2 as determined by test of May 14, 1943, at an output rate of 570,000 lb of steam per hr.

The Gas Turbine—An Engineering Possibility Today

(*Continued from page* 81)

prime mover. Thus the turbosupercharger, originally a gas-turbine by-product, has not only proved very useful of itself, but has accelerated gas-turbine development.

The turbosupercharger in the United States started in 1918 with a turbine wheel suited only for steam temperature, provided in a rush by the De Laval Steam Turbine Co. Since then there has been continuous progress in materials, fabrication, heat-treating, design, and cooling, of all of the parts, whether exposed to exhaust-gas temperatures or not.

High-Temperature Progress

One major item in operation of turbine wheels at high temperature is "creep," which is continuous nonelastic elongation, finally resulting in rupture. Hence stresses for a gas turbine to be operated in a power plant for years are lower than for a turbosupercharger in war. Information about creep is rapidly accumulating in connection with turbosupercharger as well as with other turbine work.

So the long sought gas-turbine prime mover, with temperatures much beyond the 1000 F now in use, and consequent higher efficiency, seems to be getting nearer. Of course, this same progress is paving the way for higher temperatures and higher efficiencies with the regular steam cycle and with two fluid cycles. So we can only speculate as to whether the gas turbine with its compressor, combustion chamber, and heat interchanger is going to compete with the other cycles which instead have economizers, feedwater heaters, feed and air pumps, boilers, and condensers.

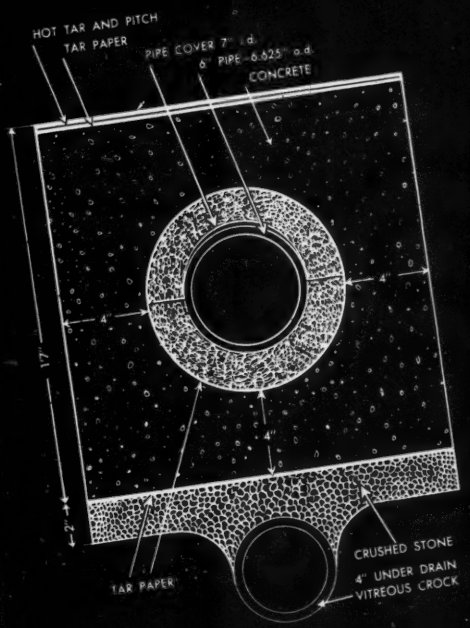
Dr. Moss has added to this paper an extensive bibliography of the gas-turbine literature, including not only many references to early discoveries and to the thermodynamics of the gas turbine but also a number of recent technical papers. Although too long for presentation here, it may be of interest to know that such a bibliography exists. A detailed article on the Combustion Gas Turbine in the Power Field, summarizing a great deal of the existing thermodynamic and application data, was published in POWER PLANT ENGINEERING, June, 1941, pp 65-68.

This is the **5TH** *in a series of messages*

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING UNARCO unibestos

5a THE PROBLEM: Permanent insulation of underground steam line.

5b THE SOLUTION: Dig underground trench to proper grade and lay sewer tile over which two inches of crushed stone is placed. Cover crushed stone with tar paper. Install pipe on wooden blocks arranged to support pipe for welding. After welding apply Unibestos sectional pipe covering to allow free movement of the pipe within the insulation, insulation should have an I. D. approximately 3/8" greater than the O. D. of the pipe. Pipes should next be brought to proper grade adjustment after waterproofing the insulation. The trench should be filled with concrete. Tar paper and tar can then be applied on top of the concrete to make the structure waterproof. The great structural strength of Unibestos permits this unique installation. Unibestos is sufficiently strong to withstand the movement and weight of the pipe.



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1st ORDER 30

2nd ORDER 57

NOW 80 MORE SPECIFIED!

A manufacturer of water filtering systems had need for accurate dependable instruments to measure the flow. After careful consideration they chose

HENSZEY FLOW INDICATORS

Due to the fine performance of these, another order soon followed for 57 more. Now 80 are needed, and the "specs" leave no doubt that Henszey Flow Indicators are desired.

They register the flow from zero to 100% indicating a pulsating flow exactly as it occurs. Graduations on the easily read dial are uniformly spaced and give the information direct—without constants. There are only three moving parts — breakdowns due to complicated gears and mechanisms are eliminated. No additional supports are needed —they go right in the line.

If you have a tough flow measuring problem consider Henszey Flow Indicators for the job—now performing in hundreds of manufacturing and processing plants from coast to coast.

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FLOW INDICATORS

Continuous Blowdown • Distilling Systems • Heat Exchangers

Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

Corrosion in Condensate Piping

(*Continued from page* 89)

in the condensate; that when the quantity of condensate flowing appreciably exceeded the trap rating (i.e., when the condensate line became flooded), practically complete dissolution of CO_2 occurred. Insofar as the writer knows, no methods of venting have as yet been devised which can guarantee a CO_2-free condensate from a CO_2-ladened steam.

DATA TYPIFYING THE CO_2 CONCENTRATIONS MEASURED IN THE GAS PHASE AT VARIOUS LEVELS IN OPERATING, EXPERIMENTAL CONDENSERS*

Sample Point Inches Above Condensate (Approx.)	CO_2 in Gas Phase** ppm
Unit A—Condensing 56 lb steam per hr	
2	713
7	280
13	102
Incoming Steam	15
Unit A—Condensing 125 lb steam per hr	
2	1485
7	730
13	206
Incoming Steam	15
Unit B—Condensing 200 lb steam per hr	
2	2948
3	2313
12	219
60	203
Incoming Steam	25

*When CO_2 in steam and that dissolved in condensate were approximately equal.

**Because a satisfactory method for measuring such high concentrations of CO_2 has not yet been developed, these figures are indicate rather than absolute.

DEMA Establishes Headquarters

HARVEY T. HILL, recently appointed executive director of the Diesel Engine Manufacturers Association, announced that effective February 16, 1944, the headquarters of the organization will be located in Chicago at One North La Salle Street.

Mr. Hill is well known throughout the field of business and in organization work. In 1916 he became associated with the Chicago Association of Commerce. He was then elected secretary of the Illinois State Chamber of Commerce. Later he became executive vice-president of the Chicago Stock Exchange. After ten years with the Exchange he left to become a partner of the stock firm of Clement, Curtis & Co. For the past several years he has been secretary-manager of the Chicago Association of Credit Men, which position he re-

NIGHT OR DAY

the Dearborn Engineer is at your service

● Dearborn Engineer lives with a hat on! He is accustomed to calls for help at all hours. Night or day, he is as near as your telephone to help you when you have trouble due to bad or improperly treated water.

Dearborn Engineer Knows Your Local Water Characteristics

● He lives and works where your plant is located. That's an advantage because he gets started quickly.

He is equally quick to detect trouble caused by improper treatment dosage or adjustment. In fact, he's an expert in preventive treatment to avoid trouble. In these days of round-the-clock boiler operation it's helpful to have this service at hand and available quickly.

Night or Day, Call Dearborn

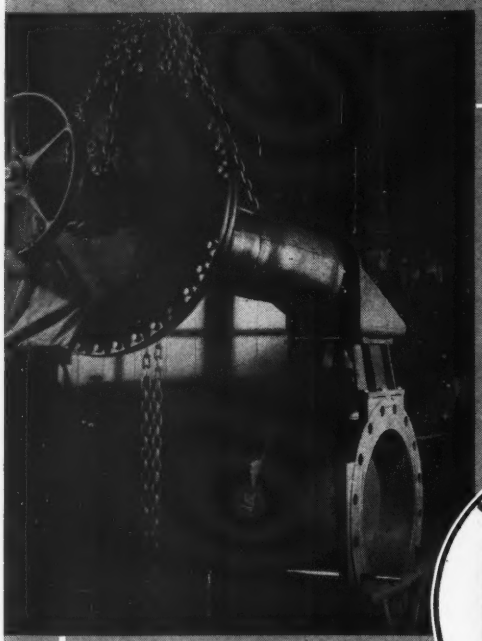
● Dearborn treatment provides full protection to eliminate scale, stop corrosion, and reduce the possibility of steam contamination. Call our nearest branch office or write . . . Dearborn Chemical Company, Dept. F, 310 S. Michigan Ave., Chicago 4, Illinois.

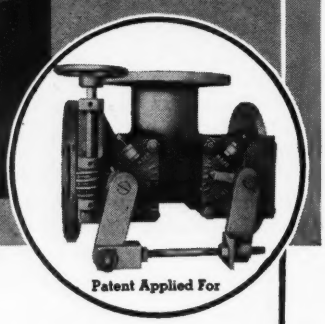
Dearborn

TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

Designed for HIGH or LOW Working Pressure





These two illustrations of R-S Butterfly Valves exemplify the wide pressure range (15 to 900 psi) handled by this type valve as well as the simplicity of design.

When completely assembled, the heavy duty power operated valve, No. 610, will be equipped with a dual stuffing box, hand wheel declutching unit, hand jack and mercury switch. Shaft supported on ball or sleeve bearings enclosed in grease packed journals—pressure lubrication.

The manually operated three-way valve, No. 611, is utilized for quick interchange and mixing service. It is adapted to power operation as well as high pressures and elevated temperatures.

This visual presentation of R-S Engineering speaks for itself. If you are interested in simplified control and shut-off of volume and pressure, write for the complete story contained in the new R-S Catalog No. 14-B.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

cently resigned to become executive director of DEMA. He is a member of the Union League Club of Chicago, the Economic Club, the Chicago Stock Exchange and the Rotary Club of Chicago, serving on various committees with a special interest in Boys' Club work.

Mr. Hill was graduated from the Engineering School of Pennsylvania State College and later received a master's degree in the School of Commerce at the University of Chicago.

The officers of the Diesel Engine Manufacturers Association are: President, Robert E. Friend, President of the Nordberg Manufacturing Co. of Milwaukee; Vice-president, Gordon Lefebvre, President of the Cooper-Bessemer Corp., Mt. Vernon, Ohio; and Treasurer, Robert H. Morse, Jr., General Sales Manager of Fairbanks, Morse & Co., Chicago.

Pulverized Coal Problems Discussed

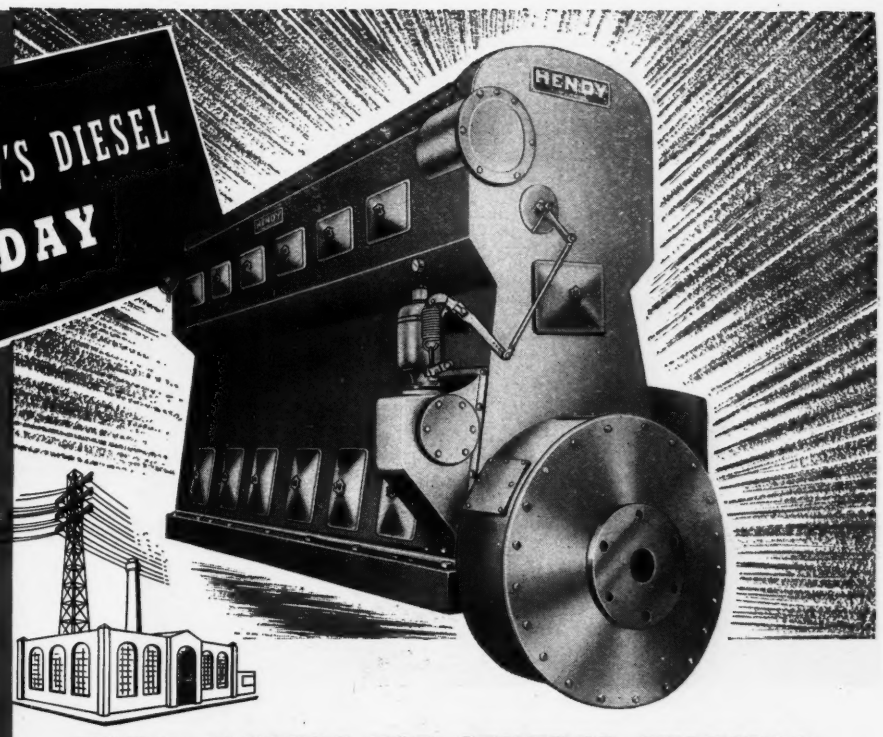
THE COMMITTEE on Industrial Utilization of the Technical Advisory Board of Bituminous Coal Research, Inc., recently held a meeting with representatives of the manufacturers of pulverized coal equipment at Battelle Memorial Institute, Columbus, Ohio, for the purpose of discussing ways in which the bituminous coal industry, in its new $500,000 research program, can advance the use of pulverized coal.

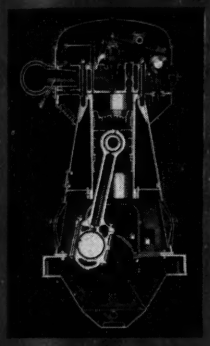
Subjects discussed were: abrasion index for metals in contact with moving coal and coal ash, the relation of surface and inherent moisture in coal to its grindability, the mechanism of combustion, the rate of flame propagation, the fundamentals of flow of coal and air in pipes, the effect of recirculation of flue gases on combustion, the fusion of coal ash, and radiation from flames. More information is needed on these subjects, it was agreed, to improve firing equipment.

Consideration was given also to the extension of the uses of pulverized coal into nonsteam uses where oil and natural gas have largely supplanted coal, such as in the open hearth furnace, cement, lime and brick kilns, railroad locomotives and the gas turbine. Some work by BCR which is already under way or completed on forge furnaces and radiant-tube furnaces was described.

To continue the cooperation demonstrated at this meeting and

TOMORROW'S DIESEL TODAY





GENERAL SPECIFICATIONS
SERIES 50

Bore—12"; Stroke—15"
Speed—350 to 600 RPM
Rated Power at 450 RPM—
75 hp. per cyl.

Write for complete data on the Hendy Series 50 Diesel Engine

HENDY DIESELS FOR CENTRAL STATIONS

Twenty-two valuable design and construction features, never before combined in any single engine, have been incorporated in four-cycle Hendy Diesels—to lower your operating and maintenance costs, and prolong engine life. More than a half century of power plant experience is reflected in Series 50 Hendy Diesel Engines... which fully utilize the latest developments in engineering and metallurgical practices.

Here are typical features that make Hendy Diesels particularly suitable for central station service:

UNIT TYPE FUEL PUMP AND INJECTORS eliminate long, high-pressure fuel lines and improve engine performance.

DUAL INTAKE AND EXHAUST VALVES are operated by a cross-head which eliminates side thrust from the rocker arms.

POSITIVE, AUTOMATIC LUBRICATION throughout engine.

DESIGN OF WELDED STEEL engine bed and cylinder block assures strength and rigidity... reduces weight.

OIL-COOLED PISTONS lower piston temperatures, prolong ring and cylinder life, reduce oil consumption.

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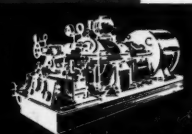
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AT PAN AMERICAN AIRWAYS . . .

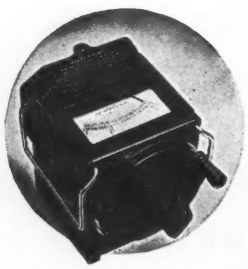
where insulation MUST NOT FAIL!

. . . THEY USE "MEGGER" TESTING INSTRUMENTS

Conditions of extreme heat, cold, moisture, vibration and corona are but some of the hazards to electrical insulation that are inherent in aircraft services. By carefully checking ignition harness, circuits and electrical equipment at frequent intervals with "Megger" Insulation Testers, aircraft maintenance men insure against electrical failures in flight.

Years ago, Pan American World Airways selected "Megger" instruments for this vital work and now, at Pan American bases throughout the world, the "Megger" tester is literally "first and last" in the ground crew's maintenance procedure.

Likewise, industry is today guarding its electrical equipment more than ever before and "Megger" Insulation Testers provide the means for this protection. Write today for a copy of our *Pocket Manual of "Megger" Practice No. 1420-PE*—which presents the why and how of "Megger" testing.



THE NEW . . . U. S.-MADE "MEGGER" INSULATION TESTER

in plastic molded case; with the heritage of ruggedness and accuracy common to all instruments bearing the trade mark name "Megger" . . . *Write for new descriptive Bulletin 1735-PE.*

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

to work up a definite program from the many good suggestions which were offered, a committee representing the manufacturers was named. The members are: Ollison Craig, J. E. Crites, and R. M. Hardgrove.

The representatives of the manufacturers in attendance were: Babcock and Wilcox Co., R. M. Hardgrove and L. S. Wilcoxson; Combustion Engineering Co., John Van Brunt; Foster Wheeler Corp., John Blizzard; Kennedy-Van Saun Engineering Co., A. R. Allen; Riley Stoker Co., Ollison Craig; Sims Co., W. A. Pettibone; and Whiting Corp., A. J. Grindle. The personnel of the Industrial Utilization Committee of BCR, which sponsored the meeting, is V. G. Leach, Peabody Coal Co., Chairman; E. C. Payne, Consolidation Coal Co.; C. J. Potter, Rochester and Pittsburgh Coal Co.; J. C. Scott, New River Co.; L. A. Shipman, Southern Coal and Coke Co.; R. F. Stilwell, Red Jacket Coal Sales Co.; M. A. Tuttle, Knox Consolidated Coal Co.

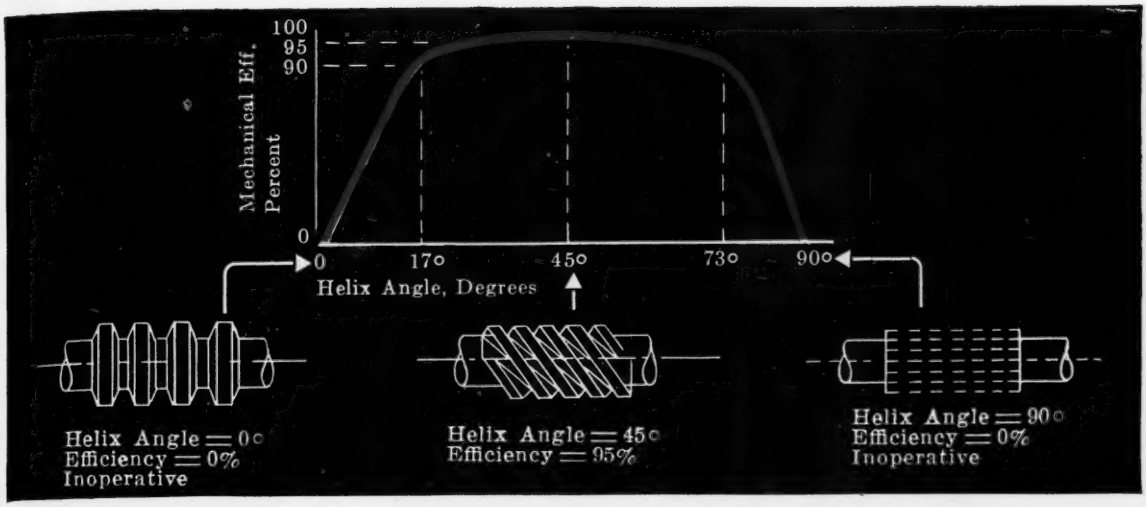
Members of the staff of the Coal Research Laboratory of the Carnegie Institute of Technology present were H. H. Lowry, Director, and A. A. Orning. Members of the Battelle staff were: R. A. Sherman, Supervisor, and B. A. Landry, Assistant Supervisor, Fuels Division; and W. H. Browne, R. B. Engdahl, and E. R. Kaiser, Research Engineers.

New Power at Grand Coulee

GRAND COULEE DAM'S tenth generator went into operation on February 12, bringing the present installed capacity of the plant, situated on the Columbia River in Washington, up to more than 800,000 kw, third largest in the world and second largest in the United States.

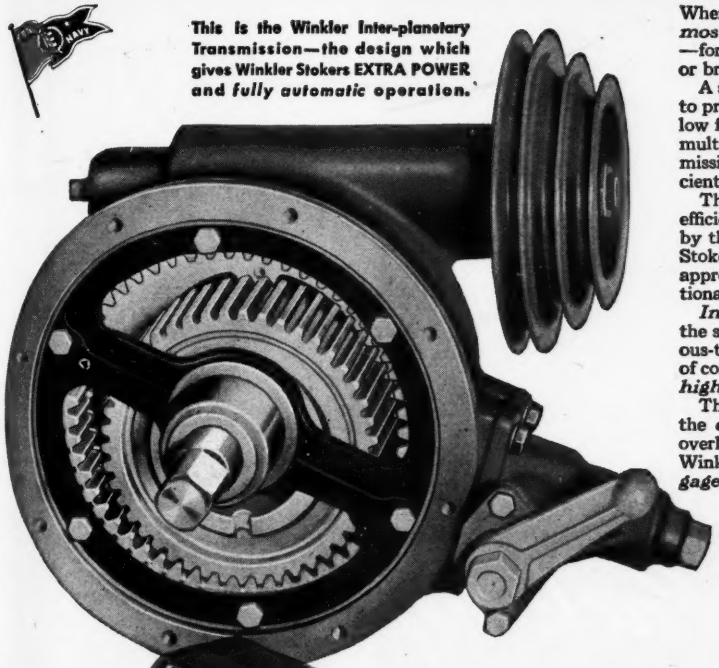
The addition of the new 108,000-kw machine brought the number of kilowatts installed at Grand Coulee Dam since February, 1943, to about 475,000 kw. The latest Grand Coulee expansion brings the installed capacity of the 30 plants constructed and operated by the Bureau of Reclamation on multiple-purpose projects in 11 states to nearly 2,200,000 kw.

At maximum development, the area is expected to support more than a quarter of a million new people on the farms and in the cities and towns on or near the project.



A CURVE TO GUIDE YOUR STOKER SELECTION

This is the Winkler Inter-planetary Transmission—the design which gives Winkler Stokers EXTRA POWER and *fully automatic* operation.



When specifying stoker equipment, ***make the most critical appraisal of the transmission*** —for at this point stoker performance is made or broken.

A stoker transmission has two functions. First, to provide a reduction from high motor speed to low feed screw speed. Second, to act as a torque multiplier. In both cases the Winkler Transmission obtains these results with the most efficient design yet developed.

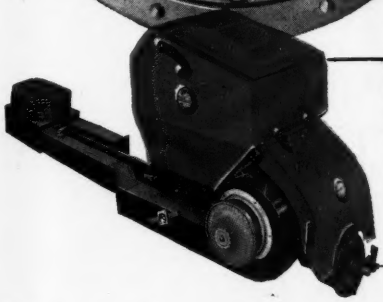
The diagram above shows clearly the high efficiency obtained in the first speed reduction by the 45° worm gear helix used in the Winkler Stoker. With this design, the tooth load is approximately 1/10 of that found in conventional transmissions.

Internal planetary gearing is used to make the secondary reduction and provides a continuous-type drive. Internal gears have a larger arc of contact, which means ***less sliding, less wear, higher efficiency and smoother action!***

These are the reasons Winkler Stokers have the ***extra power*** to overcome usual operating overloads. In the case of extreme overloads, the Winkler Safety Release automatically ***disengages and resets*** the motor and transmission until the cause is removed. ***There is no shear pin in a Winkler Stoker!***

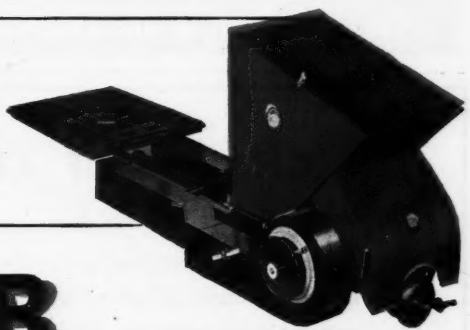
SEND FOR FREE BOOKLET

The above brief description of Winkler Stoker design is fully elaborated upon in a special engineering booklet. Every specifier of coal-burning equipment should read it.



READY FOR DELIVERY *NOW!*

Winkler Commercial and Industrial Stokers are offered through a nation-wide group of distributors and are available for immediate installation. Complete engineering service.



WINKLER

fully automatic STOKERS

U. S. MACHINE CORPORATION • LEBANON, INDIANA

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Packing Performance
at
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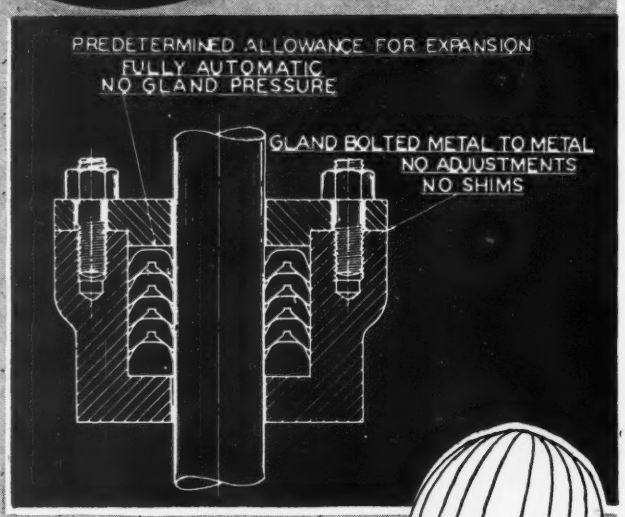

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Manufactured by A. W. CHESTERTON CO., 64 India St., Boston

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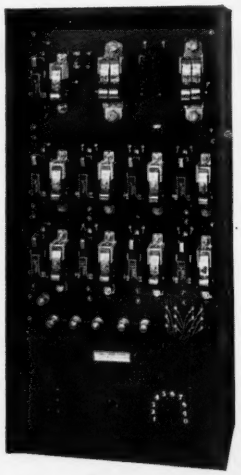
POWER PLANT ENGINEERING

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Magnetic Voltage Selector

A NEW MAGNETIC VOLTAGE SELECTOR manufactured by Zenith Electric Co., 152 West Walton St., Chicago 10, Ill., shows advanced features for precision and efficiency. This unit while especially developed for a new electro-plating process, for anodizing aluminum on alternating current, has many other uses where like applications of current are required.



The Zenith Selector is for transferring in steps from 2 to 40 v. The arrangement is such that when transferring, the main contact opens before the secondary contact opens, and closes after the secondary contact is closed. Arcing is thus effectually eliminated. The unit embodies automatic main magnetic contacts, and automatic main switch contacts for nine positions at 2½ v intervals, from 2 to 40 v.

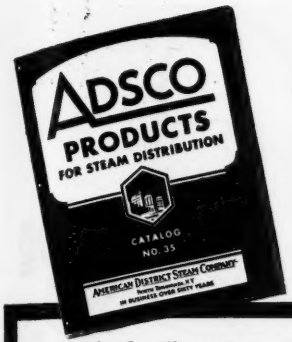
As the illustration shows the unit is conveniently paneled for ready accessibility and compactly cased.

Basket Strainers

A NEW TYPE of strainer baskets with increased straining area and rugged construction is announced by the Blackmer Pump Co. of Grand Rapids, Mich.

The new baskets are constructed from heavy-gage perforated sheet instead of the usual wire mesh and are available with various size openings. These new strainer baskets are designed to withstand far greater abuse than the old wire mesh screen which were frequently damaged during cleaning.

According to the manufacturer, the use of the perforated sheet increases the net straining area up to 10 times



Send for your copy of this
CATALOG *that describes these and other*

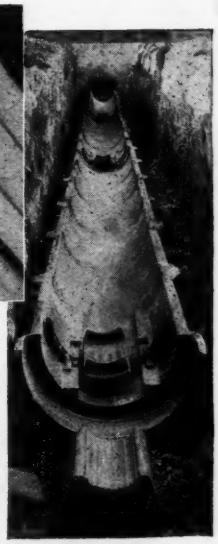
ADSCO STEAM LINE PRODUCTS

Study the illustrations on this page and you will get some idea of the complete ADSCO line of specialized equipment for steam, hot water, oil, gas or other pipe lines.

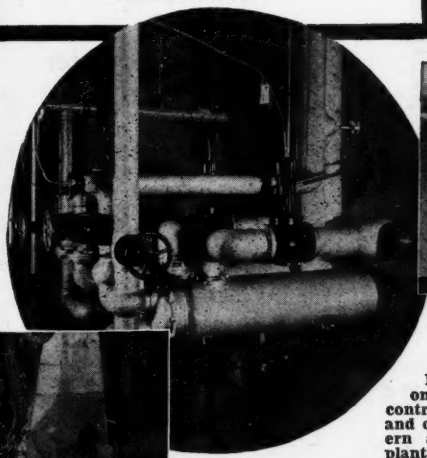
Send for your copy of the 136 page ADSCO Catalog No. 35 which illustrates and describes ADSCO steam line equipment, also auxiliary equipment such as heaters and meters, long-time favorites with some of America's largest industrial plants, utilities, colleges and institutions.

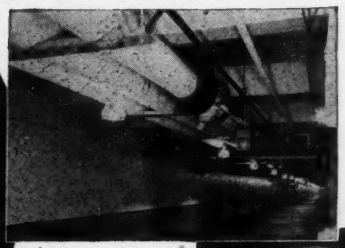
AMERICAN DISTRICT STEAM COMPANY
N. TONAWANDA, N. Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 60 YEARS

Above—ADSCO PISTON-RING EXPANSION JOINT, one of many in a Washington federal building which can be unpacked and repacked under full operating pressure.



Right—ADSCO-BANNON TILE CONDUIT assures high thermal efficiency for underground steam lines.





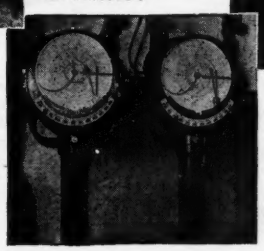
Below—ADSCO ROTARY CONDENSATION METER connected to ADSCO Heat Economizer. This low cost, easy to read meter will enable you to allocate steam consumption.

Above—ADSCO INTERNALLY-EXTERNALLY GUIDED EXPANSION JOINT, one of several that control pipe expansion and contraction in eastern aircraft accessory plant.

Above—ADSCO HOT WATER HEATERS for swimming pool. One of the many designs of Instantaneous or Storage, ADSCO "Built To Order" Heaters and Economizers.

Right—ADSCO CELL-CONCRETE "Insulation" used to re-insulate underground steam lines in Missouri.

THIS CATALOG ALSO DESCRIBES VARIOUS TYPES OF ADSCO Expansion Joints—Steam Traps—Pipe Supports—Alignment Guides—Vapor Heating Specialties.



Above—ADSCO INTERNALLY GUIDED EXPANSION JOINT, the ideal joint where space is limited and a guided joint is required.

Left—ADSCO FLOW METERS, on the job in large midwest brewery. These rugged meters cannot be damaged by sudden overload or reverse flow.

Mail the Coupon

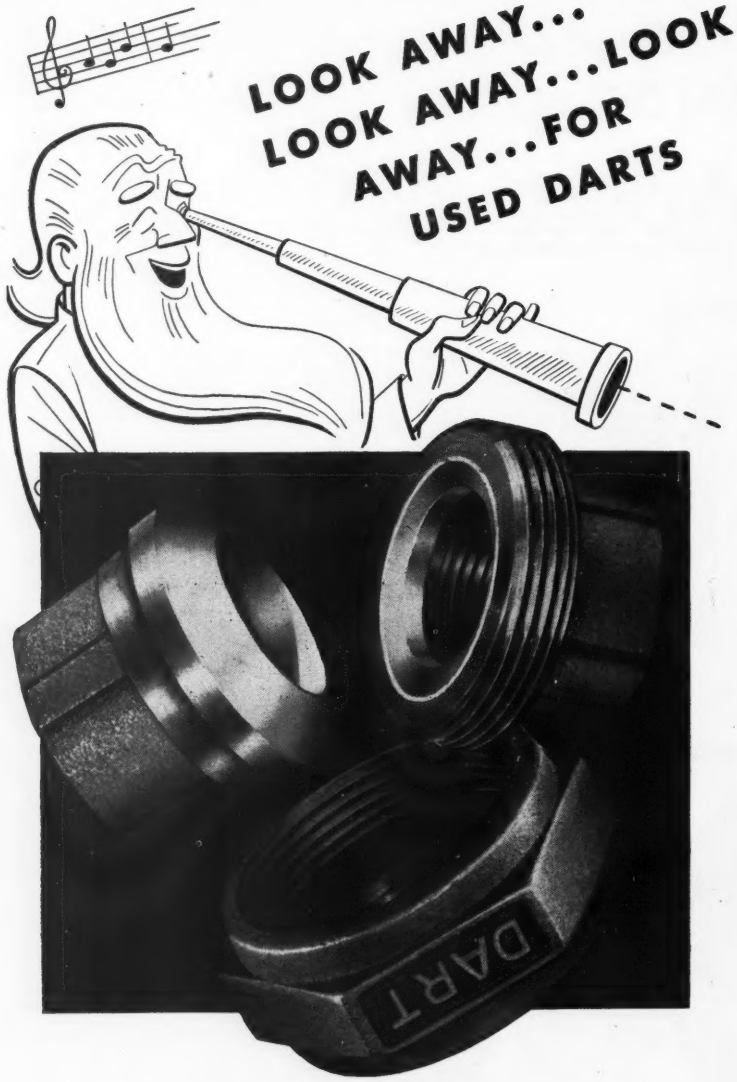
AMERICAN DISTRICT STEAM COMPANY
North Tonawanda, N. Y.

Please send me ADSCO Catalog No. 35 describing ADSCO steam line equipment.

Name .....

Company .....

Address .....



. . For Discarded Dart Unions Can Be Put Back To Work

In plants all over the country the search continues for Dart Unions that have given lots of dependable service and therefore been retired . . . *yet which have lots of dependable service still to give.*

The explanation of why Dart Unions can provide tight-joint performance *so many times* is found in Dart's design and construction. Darts have two extra-wide, non-corroding bronze seats, ground to "true-ball" surfaces. And the nuts and bodies of all Dart Unions are made of High-Test Air Refined Malleable Iron that resists pipe strains and rough handling.

Keep looking away in your plant buildings and yards for your discarded Darts. Come to your supplier for *new* Darts.

DART UNIONS

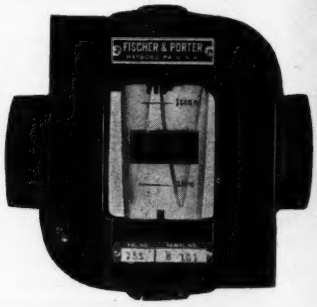
E. M. DART MANUFACTURING CO., PROVIDENCE, R. I.

the pipe area, which exceeds the recommendations of the Hydraulic Institute by a substantial margin. Part of the gain in the straining area is achieved by the use of spot welding, made possible by the perforated sheet. The welding is not affected by higher temperatures as is soldering or brazing, and reduces friction loss. Another gain is realized through the use of the heavier material. The manufacturer pointed out that use of the perforated sheet eliminates the solid frame necessary to stiffen the old-type wire mesh screen, thus permitting liquids to flow more freely through the unit.

The new perforated baskets will be used with all strainers in the Blackmer "Easy-Kleen" line.

Sight Flow Indicator

FISCHER & PORTER CO., 959 County Line Road, Hatboro, Pa., announces the development of the Rota-Sight for flow indication in any application where an approximation of the amount of flow rate is an operating aid and necessity. This simply constructed flow indicator clearly shows when a liquid or gas is passing through a line. It has an indicating float which moves up and down in a pyrex tube in direct proportion to the amount of flow. Immediate response to flow change is obtained by the pyrex tube into which triangular V-ported flutes are formed. As a result, a variable area meter is obtained giving a wide range over a short scale length. The metering tube is only 3 in. overall.



The Rota-Sight may be equipped with an alarm which is a positive and inexpensive device for visible or audible protection against dangerously low or high flows. This action is accomplished by means of a magnetic float extension which trips a magnetic switch to operate the alarm circuit. High and low alarm positions are adjustable over the entire flow range of the instrument.

Mechanical Giants
—with muscles of oil

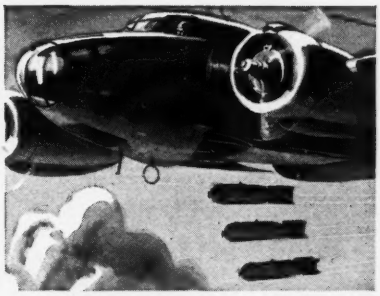
Seabees and Army Engineers are putting bulldozers to work under conditions and on jobs nobody ever thought a machine could handle before the war. They whack out roads in dense Pacific jungles. Level landslides in Italy. Build landing fields on barren Aleutian Islands. Even wipe out Jap pillboxes with these mechanical giants.

Earthmoving parts of bulldozers... like the working parts of so many modern machines ...are operated hydraulically. They get their power through relatively slender hose that must be scientifically designed and built to withstand tremendous pressures, extreme changes of temperatures and to be able to flex without excess strain.

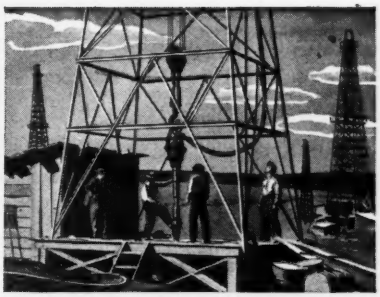
Scientific design is equally true of air hose, drilling hose, oil and gas hose...scores of different types of hose manufactured by United States Rubber Company. Many of them...like the hydraulic hose in bulldozers . . . are being subjected to new and unexpected strains and punishment in their wartime jobs. United States Rubber Company scientists are putting all their skill and ingenuity into improving the stamina and quality of U. S. Rubber Hose. The knowledge they are gaining now will be put to good use in peacetime applications.

SERVING THROUGH SCIENCE

HOSE, specially engineered to handle extremely high pressures, furnishes the power for air-hammers and compressed air drills in mines and quarries the nation over.



"BOMBS AWAY" ... and on target ... mean that hydraulic machines have once again operated smoothly and efficiently. Bomb-bay doors and landing gear are only two of many places in fighting planes where hose is on the job.



DRILLING HOSE, suction and discharge hose help keep vital petroleum flowing to the Armed Forces and to industry. Here again, hose must be scientifically designed, specially made for a specific task.

Listen to the Philharmonic Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

MONO-BLOCK

A One-block Insulation, Effective Over the Full Temperature-Range

Made from *black* rockwool, B-H Mono-block is high-temperature-resistant (up to 1700° F.) and has exceptionally low thermal conductivity. You'll find it lighter, and more efficient, too, because its long, straight fibres are interwoven in layers by an exclusive, patented process. In each block, millions of tiny air-cells hold back the heat, preventing its escape. Because it is a one-block insulation, Mono-block delivers substantial savings in installation costs, too. Send for sample and new bulletin.

Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, New Jersey; Kalamazoo, Michigan; and Huntington, Indiana.

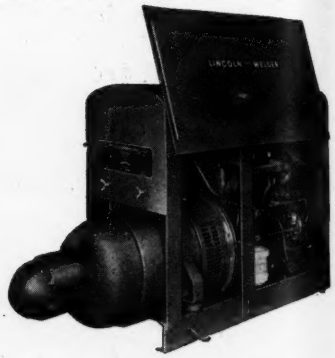
Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

Engine Driven Arc Welder

LINCOLN ELECTRIC CO., Cleveland, Ohio, has recently placed on the market a new Shield-Arc engine-driven welder rated at 200 amp. It is light in weight, rugged in construction with enclosed, rubber mounted engine of 29 hp.

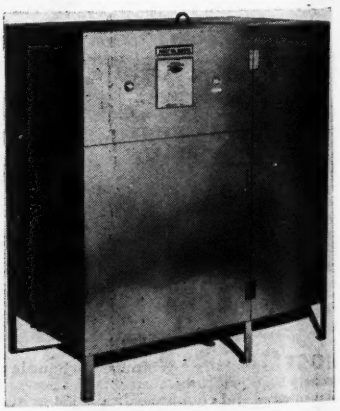


This new unit has a current range of 40 to 250 amp. Dual control of welding current is accomplished by adjustment of series fields and generator speed. Although designed especially for metallic arc welding; with bare or coated electrodes, the new model also supplies uniform welding current for carbon arc welding.

The generator control or job selector assures accuracy of open circuit voltage and permits precise control of engine speed of from 1500 to 1150 rpm for welding. In addition, this control may be used manually to reduce the engine speed to as low as 750 rpm whenever it is necessary to stop welding at intervals of a few minutes.

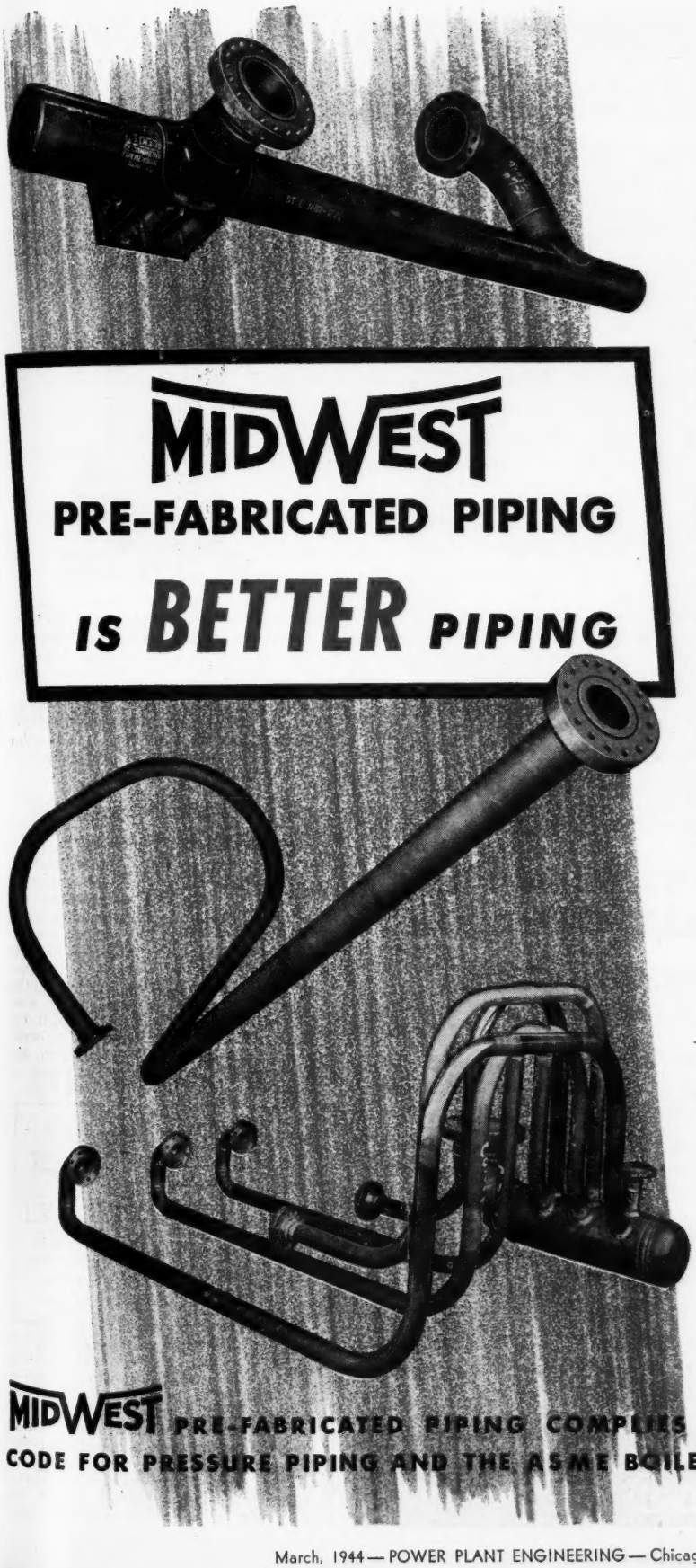
Oil Reclaimer

YOUNGSTOWN MILLER CO., Sandusky, Ohio, has announced a new line of YM "Robot" Oil Refiners, designed to clean lubricating oil with continuous and automatic operation.



This machine, which is said to add new efficiency, convenience and economy to the widely used YM process of cleaning oil, utilizes common refinery earths available on the open market. It is capable of removing fuel dilution, acids, solid and colloidal carbon, dirt, and similar matter; also, it can restore oil emulsified by water.

A single machine of this type can be installed to serve an entire power plant, whether large or small. Ability



MIDWEST
PRE-FABRICATED PIPING
IS BETTER PIPING

Piping specialists operating complete plants using the most modern equipment and methods assure that Midwest pre-fabricated piping is accurate in dimension and alignment . . . carefully shop tested . . . thoroughly cleaned and inspected . . . and heat treated and stress relieved when necessary.

Nationwide experience in satisfying the piping needs of all types of industries and an aggressive program of piping research enable Midwest frequently to make suggestions that simplify piping layout . . . save time and materials . . . and reduce costs.

For these reasons, you will always find it advantageous to use Midwest Pre-Fabricated Piping (whether purchased on the basis of materials only or materials completely installed.)

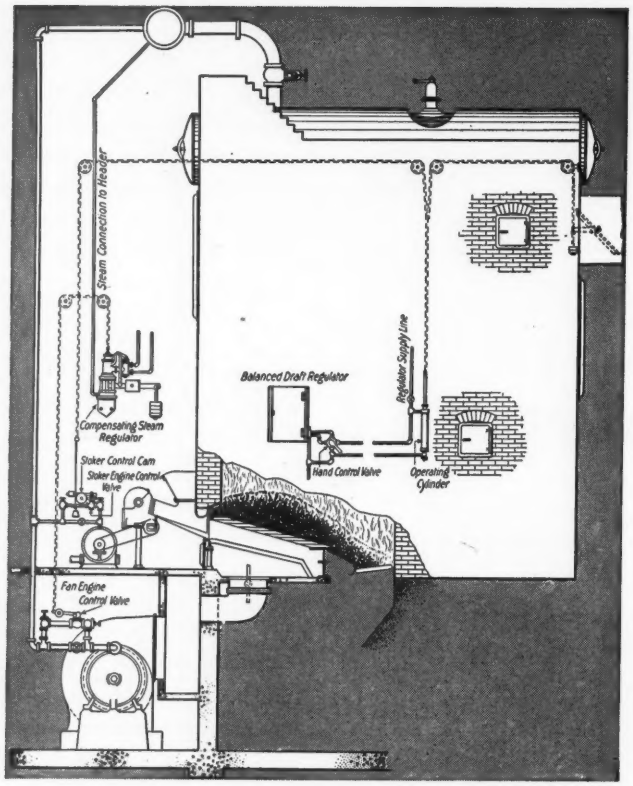
MIDWEST
PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Building Houston—229 Shell Building • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Building.

MIDWEST PRE-FABRICATED PIPING COMPLIES WITH BOTH THE ASA CODE FOR PRESSURE PIPING AND THE ASME BOILER CONSTRUCTION CODE

Enco Balanced Draft



A PRACTICAL SYSTEM THAT AUTOMATICALLY CONTROLS

. . . FURNACE PRESSURE, STEAM PRESSURE, FANS AND STOKERS

You can get all the advantages of balanced draft with the Enco system which conforms to accepted practices of combustion control and yet is simple and easy to install and maintain.

It is adaptable to all methods of coal firing . . . stokers of the underfeed, overfeed, spreader or traveling grate types, as well as hand-firing.

The apparatus is so free of complications and delicate mechanisms that it can be installed by your own maintenance crew and kept in operation with the greatest ease.

It may be either hydraulically or pneumatically actuated.

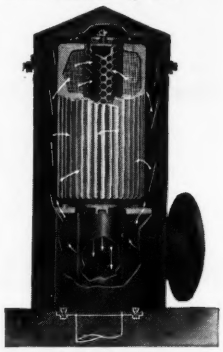
Ask for bulletin B.D. 43 on "Combustion Control" and get the facts on this practical, low cost system that has been in use for over 25 years on more than 1000 boilers.

THE ENGINEER COMPANY
75 WEST STREET Enco NEW YORK, N.Y.

to restore transformer oils to 30,000 v dielectric strength is also claimed for this machine.

Intake Air Filter

DOLLINGER CORP. (formerly Staynew Filter Corp.), has recently developed a new intake filter for compressors and internal combustion engines. This new filter may be installed and subsequently serviced at ground level—in the engine room itself, if preferred—while the air intake opening may be located elsewhere at the most suitable point.

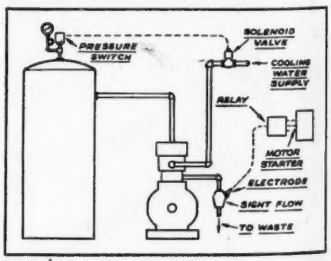


The new filter provides all the advantages of the Staynew and Protectomotor dry type intake filters, including the Radial Fin Construction. Combination silencer-and-filter models are available.

Servicing is extremely simple, as the actual filter insert can be lifted out through a removable panel, and either cleaned by brushing, by compressed air, or by washing.

Control for Water-Cooled Compressors

A NEW COMPRESSOR control developed to protect water-cooled compressors against the damaging overheating that results if operated without cooling water, and at the same time to prevent unnecessary and costly waste of water, has been announced by the Johnson Corporation of Three Rivers, Mich. By permitting the compressor to operate only when water is actually flowing through it, this control guards against failure of water supply from any cause whatsoever, and consequently permits the safe use of automatic water cut-off valves.



This device consists of a sight flow fitting, mounted in the water discharge pipe of the compressor, which serves as a holder for a metal electrode. When pressure in the receiver falls below the predetermined value, the pressure switch on receiver opens a solenoid controlled valve to admit cooling water to the compressor. The compressor is not started until water flows through it and into the sight flow, completing the circuit

"IN 6 MONTHS THIS VOLTAGE REGULATOR PAID FOR ITSELF TWICE OVER IN SAVINGS IN PAPER AND MAN-HOURS"

. . . reports blueprint-machine user

PROBLEM A large Midwestern plant was experiencing considerable trouble in its blueprinting department because of fluctuating voltage. This poor voltage condition was caused by a varying power and lighting load. The high-intensity, mercury-vapor lamps being used in blueprinting were burning out needlessly. Large quantities of blueprint paper were being wasted because it was necessary to make trial prints at various times of the day to determine proper exposure. There was also a waste when making microfilm records of large-size prints, because varying voltage caused a varying intensity of light and, hence, underexposure or overexposure.

SOLUTION No *special* equipment was needed to lick the problem. General Electric engineers suggested two 3.6-kva, 240-volt, automatic, dry-type, induction voltage regulators, selected from our standard AIRS line.

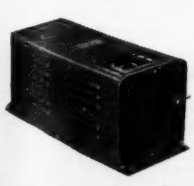
RESULTS Now, after less than six months, the manufacturer reports that these *automatic* regulators have already paid for themselves at least twice—in materials plus man-hours saved. Under the old setup, it was necessary to adjust the voltage by hand several times a day.

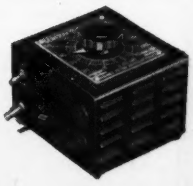
WHAT'S YOUR PROBLEM? Pepless motors, poor lighting, uncertain test results, and production slumps are often the result of poor voltage. Whether you need voltage control for a vacuum tube or a power shovel, there's a simple, economical G-E device for the job. *General Electric Company, Schenectady 5, N. Y.*

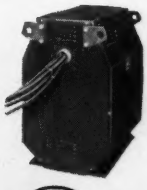
3.6-kva, automatic, induction voltage regulator (Control panel is mounted separately.)

OTHER G-E AIDS TO BETTER VOLTAGE

VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters. **VARIABLE-VOLTAGE AUTO-TRANSFORMER**—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment. **TYPE D TRANSFORMER**—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage for the most economical operation of motors, welding equipment, etc. Ratings up to 100 kva, 600 volts.







THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB BETTER

BUY WAR BONDS

GENERAL ELECTRIC

403-64-5206
5400

SAVE COAL

—with FYR-FEEDER Multiple SPREADER Stokers

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of wet or dry bituminous coal you have available locally—screenings or sweepings, any melting point of ash, free-burning or coking coals.

Burns Coal like Oil: FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed—no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle increased loads.

FYR-FEEDER is our own original design. FYR-FEEDER is not a copy of any other stoker but our own invention developed by us, and our engineering experience with spreader stoker design, installation and operation began in the last century.

WET COAL IS NO HANDICAP

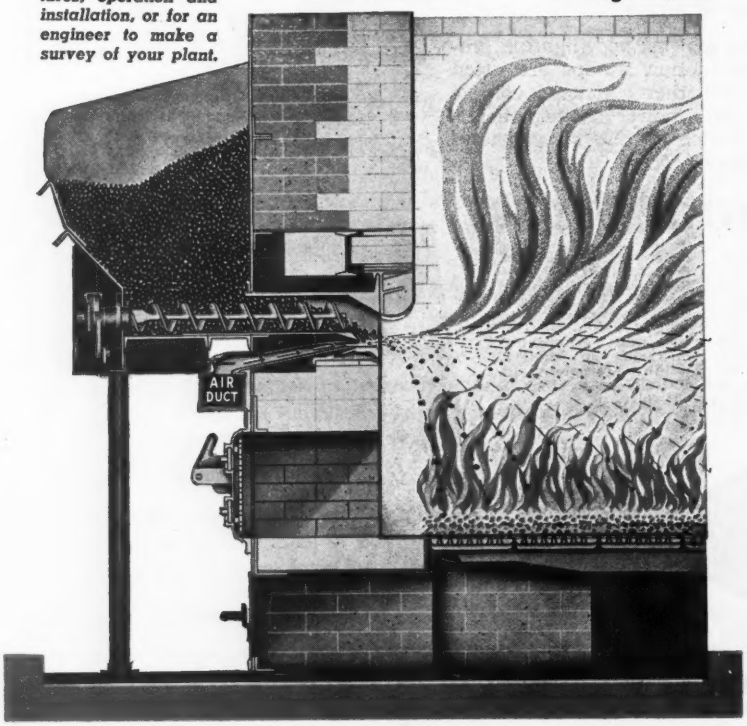
Coal men like the FYR-FEEDER because FYR-FEEDER users do not insist upon the delivery of "DRY" coal since FYR-FEEDER handles "WET" coal satisfactorily. Regardless of "rain and snow watered" coal, FYR-FEEDER stokers produce plenty of steam from "WET" coal. FYR-FEEDER was designed to use "WET" coal or dry coal.

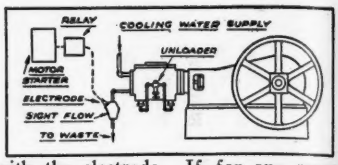
AMERICAN COAL BURNER COMPANY

—Engineers—

WRITE FOR CATALOG describing features, operation and installation, or for an engineer to make a survey of your plant.

22-18 E. Erie St. Chicago 11, Ill.





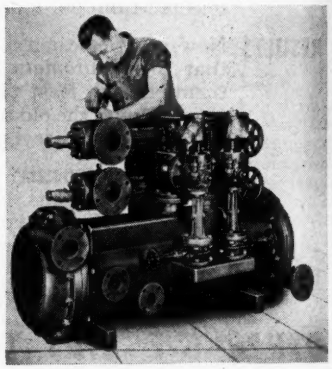
with the electrode. If for any reason water supply fails the compressor will not be started, or if operating will be stopped immediately.

This arrangement of the Johnson control is designated as Type M. By supplying cooling water only while compressor is actually operating, it will prevent costly waste of water in those many installations where cooling water is left running all the time, even though the compressor operates only intermittently. The new control is also available as Type U, for use on unloading compressors. It insures that cooling water is flowing before compressor starts, and stops compressor or sounds warning alarm if water supply fails.

Operation of the new control is completely automatic and as dependable as the flow of electricity. It can be used for compressors of all sizes, and can be adapted to practically all operating conditions.

Elliott Marine Ejector

THE NEW MARINE type steam jet ejector developed by Elliott Co., Jeannette, Pa., is a twin two-stage ejector with combined inter- and after-condensers of the surface type. It is designed for the compactness necessary to marine installation and can be bolted directly to the bulkhead with all pipe connections accessible on one side.

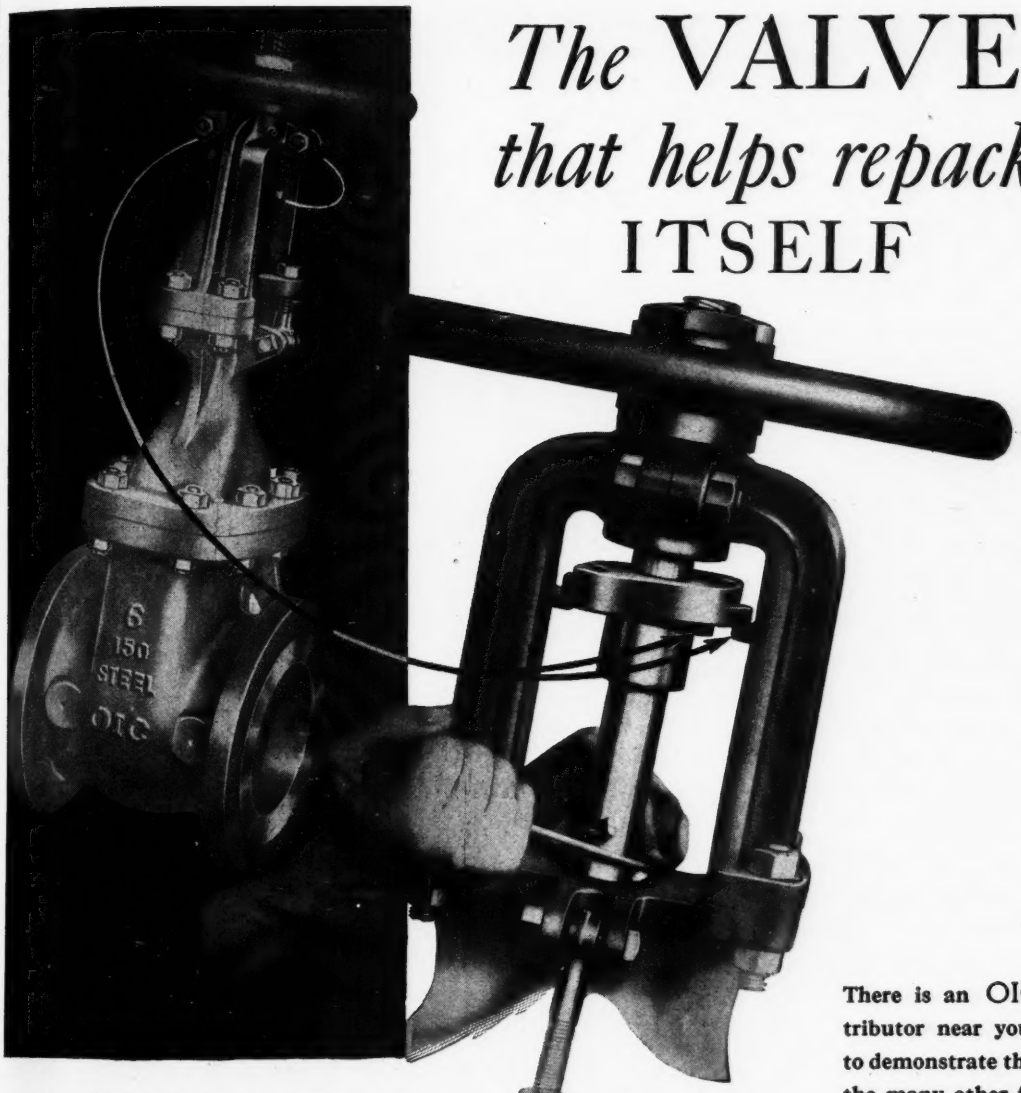


All four ejector stages are provided with isolating valves so that any stage can be removed without interfering with the operation of the others. All valves are accessible. Each ejector stage is equipped with a single nozzle and each has its own self-cleaning steam strainer with removable screen and blowoff connection.

Each stage is also equipped with a sentinel relief valve for protection in case the operator should turn on steam with the isolating valves closed. The after-condenser has extra surface to condense the gland leak-off steam from the propulsion turbine, thus eliminating a separate condenser for this purpose.

This ejector unit is one of several being built to serve Elliott 6000-sq ft marine condensers installed on cargo vessels. Elliott Co. is also furnishing the auxiliary condensers which are equipped with ejectors of this same type.

The VALVE *that helps repack* ITSELF



HERE'S the Steel Valve that actually helps to repack itself under pressure, enabling you to do a faster, better job.

The gland and follower are held together by self-locking lugs and are raised as one unit for repacking. The grooved ears on the gland fit into tongued shelves on the yoke when in the raised position.

Eye-bolts hold the entire unit down firmly on the packing. In the repacking process they swing down out of the way — never to be lost or misplaced.

These are just a few of the exclusive features and time and money saving advantages of OIC Steel Valves.

There is an OIC Distributor near you ready to demonstrate these and the many other features of OIC Steel Valves to you. Call him, or write to us for complete details.

ARMY E NAVY

OIC

THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883

Order of the day:

CONSERVE FUEL

HENSZEY CONTINUOUS BLOWDOWN

Permits full production with great savings of fuel!

Our government's emphasis on the conservation of fuel calls attention to the saving made possible by the installation of Henszey Continuous Blowdown. The Henszey system keeps boiler water concentration within safe margins—preventing foaming, priming, and the formation of sludge and scale (with proper chemical treatment). Remember, a clean boiler—requires less fuel to carry the power load.

The Henszey system accomplishes this without the heat loss of ordinary intermittent blowdown—a big item in the conservation of those vital B. T. U.s.

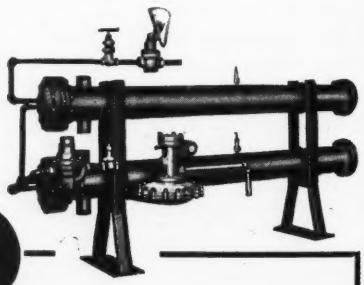
While fuel conservation is now a patriotic necessity, fuel savings and lower manpower requirements mean lower power costs—truly important to consider in the competition of tomorrow.

Henszey engineers will gladly make an analysis of your plant, presenting practical suggestions to show what savings can be made by proper boiler water concentration control. We offer our assistance to help you apply for WPB authorization for current installations.

HENSZEY CO.

Dept. C3

Watertown, Wis.



HENSZEY

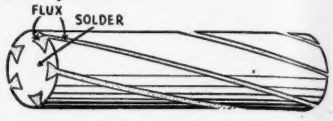
CONTINUOUS BLOWDOWN

Flow Indicators • Distillation Systems • Heat Exchangers

Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

Fluxed Solder

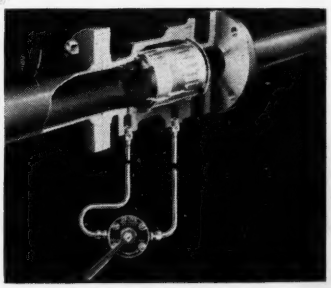
FLUXED WIRE SOLDER, with the flux in longitudinal grooves on the surface rather than in the core, has just been placed on the market by National Lead Co., 111 Broadway, New York. With the new material, called Fluxrite, the flux liquefies and flows onto the work before the solder melts. This insures thorough fluxing and results in strong solder joints.



In addition to pre-fluxing, the new solder also is said to guarantee an unbroken flow of flux. Since the new product has more than one flux-filled groove, there is naturally a continuous flow at all times. Also since the flux supply is outside the wire, it is always visible to the user.

Remote Control Valve

THE GROVE FLEXFLO remote control valve recently developed by the Grove Regulator Co., 6491 Green St., Oakland 8, Calif., is a distinct and radical departure from conventional types of valves in design, construction and operation. Identified as an "expansible tube type" valve, it initiates an entirely new class of valves. This valve operates by manual or automatic remote control on the hydraulic principle of balanced and unbalanced fluid line pressure, and virtually no external force is required, even for large valves.



Designed for cold fluid service, these new valves are especially suited for handling water, salt water, chemical solutions, oil, gases and air. Due to the fact that they utilize just one non-metallic operating part they are extremely resistant to corrosion and erosion as well as electrolytic action and are automatically self compensating for wear.

Their assembly consists of but four parts: the valve body, the flange head, a slotted pipe-like core with a solid barrier in the center, and a cylindrical flexible tube. This resilient tube is stretched tightly over the core. Both the tube and core slip into the valve body as a unit and are firmly held in place by the bolted flange head. The flanged ends of the tube serve as a leak-proof gasket sealing off an encircling pressure chamber from the flow stream. Existing fluid pressure in the line forces the tube to fully expand against the inner wall surface of the encasing valve body, thereby opening the valve and permitting a constantly smooth flow. This occurs when the remote control valve is closed.

By opening the small remote control

THE ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMP . . .

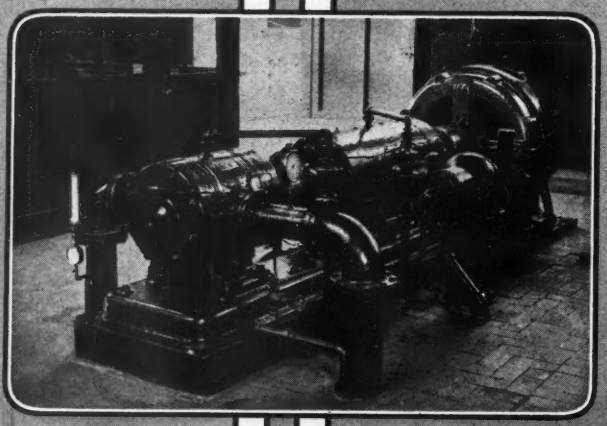
. . . for MAIN BOILER FEED and DESUPERHEATING SERVICE

Aldrich-Groff Pumps provide for automatic or remote manual control of delivery, from zero to full capacity, at constant pump speed. Rate of delivery is controlled by varying the length of the plunger stroke, and power consumption is almost directly proportional to pump delivery. These pumps combine the positive displacement and high efficiency of the plunger type pump with the flexibility and smoothness of a centrifugal.

The use of these pumps with unit feed systems eliminates the pressure and power losses associated with throttling-type feed-regulating valves. They provide advantages of feed system simplicity, efficiency and mechanical reliability for the small and medium boiler plant using medium and high steam pressures, and for de-superheater feed service in even the largest power stations. Over 100 units in operation on land and sea with outstanding service records.

Write today for the Aldrich Bulletin 65. It gives full details, sizes and ratings of Aldrich-Groff "Powr-Savr" Pumps.

THE ALDRICH PUMP CO. ALLENTOWN, PENNA.



ROTARY COMPRESSORS

Fuller Rotaries are doing their part for victory in many war industry plants. Shown above is one of fourteen Fullers doing duty for an eastern steel company, running night and day with minimum time out for repairs.

They'll still be running long after victory has been attained and, at maintained original capacities . . . because they're built for just that kind of service. Simple design, rugged construction . . . only three moving parts: rotor—bearings—blades.

Bulletin C-5 illustrates and describes these machines. It's yours for the asking.

fuller

COMPANY

CATASAUQUA, PENNSYLVANIA

CHICAGO — MARQUETTE BLDG.

SAN FRANCISCO — CHANCERY BLDG.

C-95

FULLER

PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

valve, line pressure is diverted into the actuating chamber and establishes a pressure balance on the inner and outer walls of the expansible tube. The tube then "flexes" closed over the surface of the core. Static line pressure then maintains a positive bubble-tight, air-tight shut off of the Flexflo valve.

In its compactness it requires no more head room than a pipe. Several Flexflo valves can be controlled from a central remote control station. This valve can be operated hydraulically or pneumatically by various systems such as manual, electro-solonoid, mechanical or automatic remote control.

Design For Arc Welding

GOOD STRUCTURAL DESIGN involves considerably more than provision of adequate material to withstand known or calculated stresses, according to a statement made recently by Robert E. Kinkead, consulting engineer of the Hobart Brothers Co. Among the factors which limit the choice of design he enumerated the following:

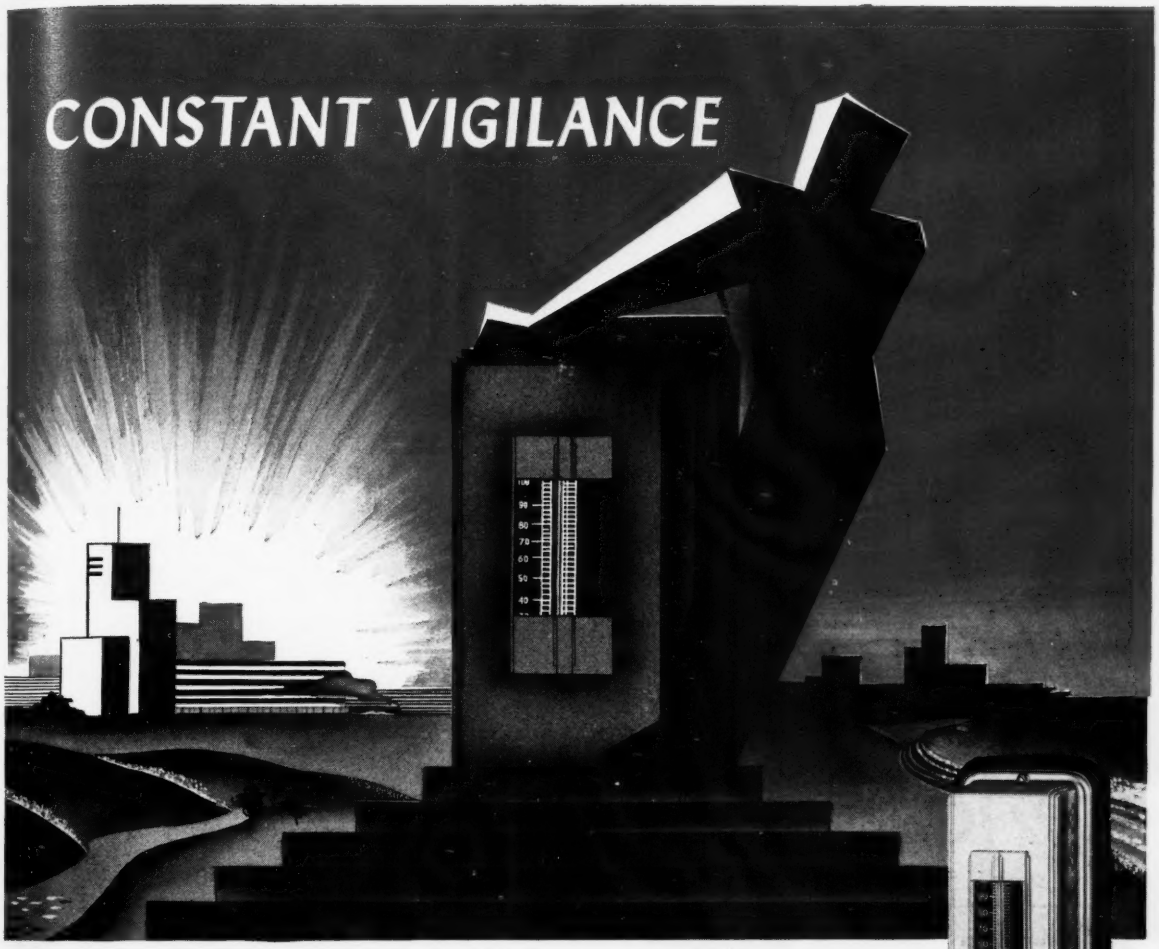
1. Number of units to be built
2. Available machinery and equipment
3. Available materials
4. Personnel skilled in the trade
5. Permissible weight
6. Permissible size in view of shipping limitations
7. Intended service life
8. Attractive appearance

The fact that the designer usually has several possible solutions to a design problem in using welded construction enables him to meet situations which would otherwise be difficult. Structural shapes, plate, slabs, and pipe as well as tube, he stated, have been used in welded design to build structures of widely different functions.

Many designers of general industrial equipment have developed great skill and ingenuity in solving their problems with welded designs. Among designers it has been found that it is often helpful in getting started on a job to see what other designers have accomplished with welded design, even though the other men's work may have been done in an entirely different line of equipment. In this connection, a designing service called "Practical Design for Arc Welding" has recently been made available by the Hobart Brothers Co., Troy, Ohio, illustrating a design for over 250 different machinery applications. In many cases several solutions to the same problem are shown but no attempt has been made to show all of the possible solutions.

The combination of flame-cutting and arc welding has become very widely used in recent years, according to Mr. Kinkead, and manufacturers will more and more turn to replacement of castings by arc welded assemblies of special flame-cut parts and standard structural members to meet the new demands of industrial design and manufacture initiated by war production experience. An important consideration when planning the introduction of a new product or the improvement of an old one is selection of the most suitable material available for the purpose, with due regard for:

(a) Greatest strength with minimum weight and bulk.
(b) Longest useful life under required service conditions.
(c) Adaptability of the most economical production method.



JOHNSON *Automatic* CONTROL

PAYS DIVIDENDS IN . . .
Protecting Health, Assuring Comfort, Saving Fuel

Unerringly . . . day and night . . . in thousands of buildings . . . Johnson precision equipment maintains proper temperatures. Constant vigilance is the watchword!

★ For efficient comfort and good health —
★ For best results in industrial processing —
★ For greater fuel economy —
★ For years of trouble-free service —

Use Johnson temperature control equipment.

No matter what your temperature, air conditioning or humidity control problem . . . get in touch with the Johnson branch nearest you.

Experienced Johnson engineers are available for consultation and to design complete control systems for new and existing buildings.

To keep present installations operating at peak efficiency, Johnson mechanics are ready to make necessary maintenance repairs and adjustments.

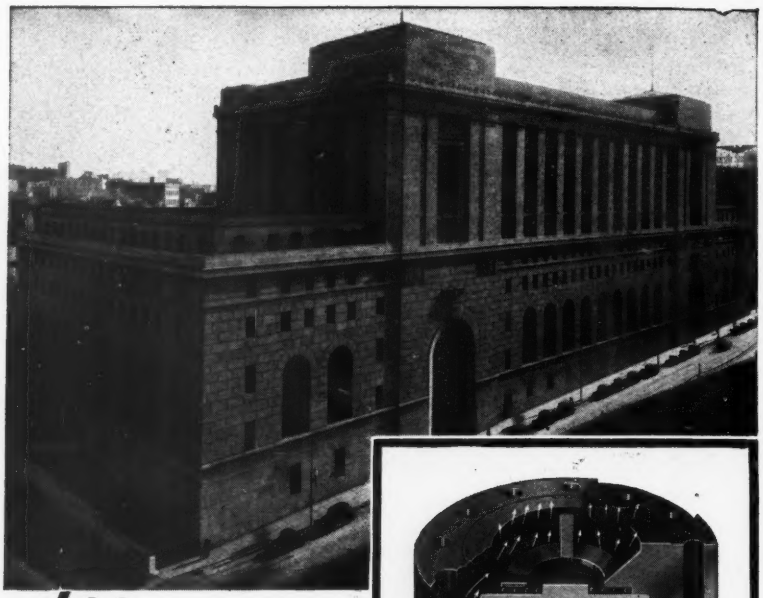
Write, wire or phone! No obligation of course.

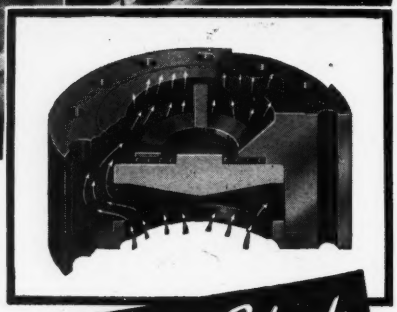
FOR VICTORY'S SAKE
BUY MORE BONDS

Fuel-Saving Starts With CONTROL

JOHNSON Automatic TEMPERATURE AND AIR CONDITIONING Control

JOHNSON SERVICE COMPANY, MILWAUKEE 2, WIS. • BRANCHES IN ALL PRINCIPAL CITIES





WILLIAMS-HAGER

FLANGED *Silent* CHECK VALVES

Williams-Hager Installations Include:

U.S. Federal Courts and P. O., Pittsburgh, Pa. (Above)

Tennessee Valley Authority, Fontana, N.C.

Statler Hotel, Washington, D.C.

Mellon Art Gallery, Washington, D.C.

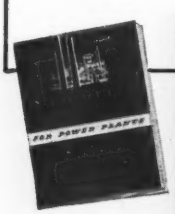
Radio City New York City

Kaiser Co., Inc., Fontana, Calif.

Standard Oil (Indiana) Whiting, Ind.

Tight under *every* condition of service and pressure—WILLIAMS-HAGER Flanged Silent Check Valves assure unrestricted and uninterrupted flow of liquids. No webs to hamper flow . . . operates in any position . . . and of simple, compact design.

Available in iron, semi-steel, bronze, cast steel, stainless steel or monel . . . 1″ to 20″ inclusive, pressure resistant to 6000 pounds.



Write for this interesting brochure

THE WILLIAMS GAUGE COMPANY

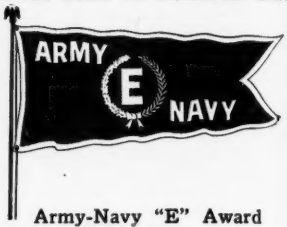
Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 Pennsylvania Ave., Pittsburgh 12, Pa.

(d) Lowest overall cost, meeting above requirements.

When the material has been selected on this basis, and particularly when arc welding proves to be the most economical production method, the designer will find that the element of attractive appearance under modern standards will take care of itself, if he concentrates his efforts on designing from already proven design suggestions.

It is surprising, too, what can be accomplished in the way of designing for efficient service, economical production, and modern appearance, as well as repairing machinery needed for service, by making use of materials suitable for arc welding that are available in readily accessible stocks for immediate delivery.



Army-Navy "E" Award

Alloy Steel Products Co. *
Linden, N. J.
Babcock & Wilcox Co. *
Refractories Div. Augusta, Ga. Works
Brown Instrument Co. *
Philadelphia, Pa.
Cochrane Corp.
Philadelphia, Pa.
De Laval Steam Turbine Co. *
Trenton, N. J.
Hanlon-Waters, Inc.
Tulsa, Okla.
Moore Steam Turbine Div. *
Worthington Pump & Machinery Corp.
Wellsville, N. Y.
Pittsburgh Piping & Equipment Co.
Pittsburgh, Pa.
Worthington Pump & Machinery Corp. *
Harrison, N. J.

Maritime Commission "M" Award

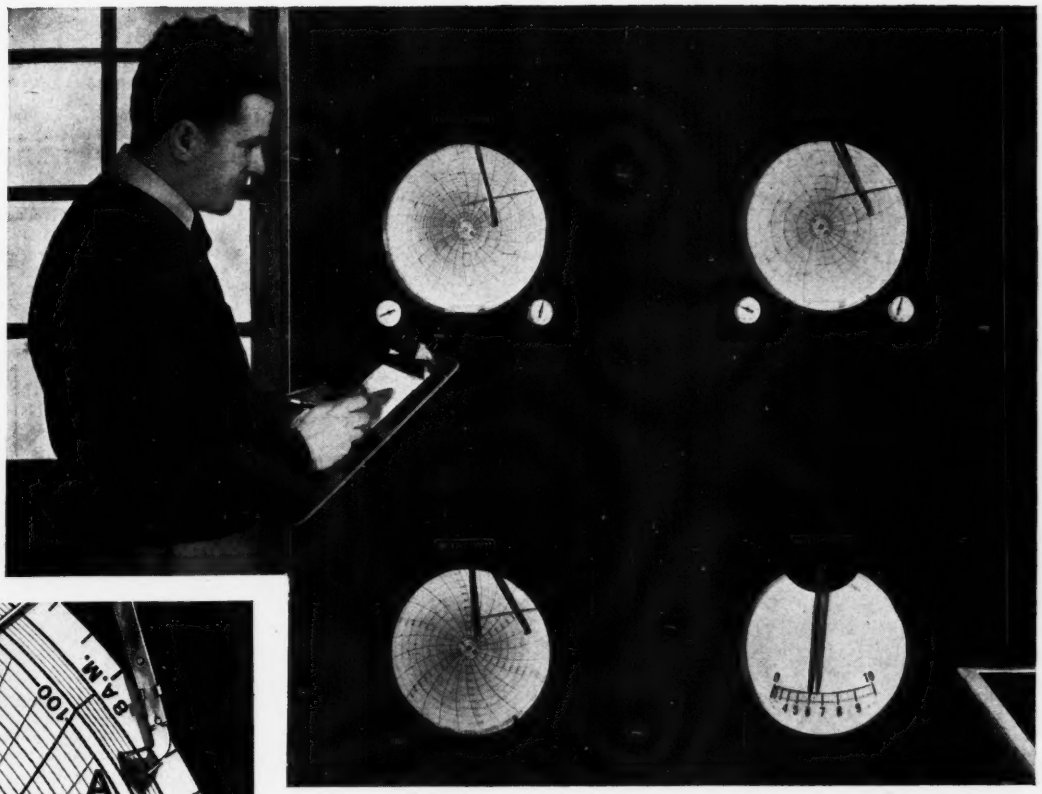
C. Lee Cook Mfg. Co.
Louisville, Ky.
The Cooper-Bessemer Corp. *
Mount Vernon, Ohio and Grove City, Pa. Plants.

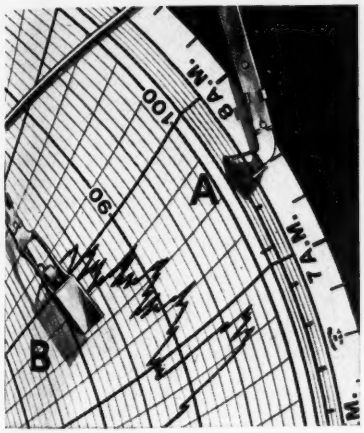
* Star added for sustained high achievement in production of war equipment.

MANUFACTURERS' PERSONALS

Lyman D. Warner has been appointed Sales Manager of the Crocker-Wheeler Division, Joshua Hendy Iron Works, Ampere, N. J. Mr. Warner has been assistant sales manager since 1941 and active in the sale of motors, generators and flexible couplings for Crocker-Wheeler since 1937. Prior to his connection with Crocker-Wheeler he was associated with the Ingersoll Rand Co. and the General Electric Co. in Schenectady, New York, and Chicago.

Thomas H. Flaherty has been appointed head of the construction and engineering department for the five American-Marietta Co. plants. Mr. Flaherty, who will direct the paint company's building expansion program, was formerly with the Austin and Kroeschell Engineering Companies.





These records are your receipt for every dollar spent for fuel.

Automatic planimeter pen record "A" shows steam flow in volume units and the time at which it was reproduced or used in any part of the 24-hour period, enabling you to easily analyze steam production and distribution.

Record line "B" shows rate of flow and enables the operators to maintain the most efficient boiler operation, thus effecting substantial fuel savings.

WHY YOU SHOULD USE FLOW METERS

Steam costs are important costs—Do you know *what* you are getting for these costs? Do you know *where* it is going? Knowing this, you can make substantial savings not only in the boiler room but in every department or unit where steam is used.

This double saving is made possible by the dual records on every Brown Steam Flow Meter Chart.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records reveal instantly any deviation above or below the most efficient operating standards of steam generation and distribution.

Thousands of steam engineers are getting this kind of service from Brown Flow Meters. They are easy to install—parts are simple and few. In many plants, the investment for Brown Flow Meters has been repaid many times over. Learn more about them. Write for Catalog No. 2008.

THE BROWN INSTRUMENT COMPANY, 4491 Wayne Avenue, Philadelphia, Pennsylvania, a division of Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota. Offices in all principal cities. 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England—Nybrokajen 7, Stockholm, Sweden.

BROWN FLOW METERS

... MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS ...

To Measure and Control is to Economize

A. D. Robertson has been appointed by Allis-Chalmers Mfg. Co. as assistant manager of the motor division at its Norwood Works, Norwood, Ohio. This plant manufactures all but the larger sizes of Allis-Chalmers motors. Mr. Robertson was transferred from the company's electrical department in Milwaukee, where he had charge of the marine section.

The board of directors of the American Locomotive Co. has appointed C. D. Williams Vice President and General Counsel in charge of the corporate and legal affairs of the company and Carl A. Sundberg, formerly Assistant Treasurer, was appointed Secretary. Mr. Williams has been a member of the law firm of Maclay, Lyeth and Williams since 1938 and for seven years previously was a member of the firm of Rumsey and Morgan. He has represented the American Locomotive Co. in various legal matters since 1930.

Mr. Sundberg joined the American Locomotive Co. in 1940 and was named Assistant Treasurer in 1941. Previously, for 13 years, he was with the Guaranty Trust Co. of New York. A graduate of the United States Naval Academy, he served from 1920 to 1924 in the Navy. He was a member of the faculty of Columbia University from 1930 to 1941, as a lecturer on financial subjects before evening classes. For four years, from 1936 to 1940, he was a member of a five-man national advisory committee on the curriculum for the national organization of the American Institute of Banking.

C. B. Allen has been transferred from Washington to the Detroit District of The Reliance Electric & Engineering Co., Cleveland, as an application engineer.

Mr. Allen was for some time connected with the Philadelphia and Boston Districts of Reliance. He takes up his Detroit duties following completion of an assignment with the Bureau of Ships, Navy Department, in Washington, for which Reliance had lent his services.

G. Bronson Philhower has recently been added to the staff of the New York office of Tube Turns, Inc., to represent the firm in the metropolitan New York area and New England. Mr. Philhower, who was a naval engineer in World War I, has for years been connected with eastern pipe fabricators and distributors, and has had experience covering the field from mill apprentice to district sales manager.

R. W. Owens has recently been appointed assistant to the president of Elliott Co., Jeannette, Pa. Mr. Owens is a native of Illinois, and following post graduate work at the University of Illinois in 1915 he joined the staff of Westinghouse where he was successively a section engineer, manager of the industrial motor engineering department, general manager of industrial engineering, and manager of the motor division in complete charge of engineering, manufacturing and sales.

A. J. Tigges has been appointed manager of consulting engineering for all divisions and subsidiaries of The Baldwin Locomotive Works, Philadelphia, including Locomotive and Ordnance, Southwark, Standard and Foundries Divisions, The Pelton Water Wheel Co., and the Whitcomb Locomotive Co. Besides his duties as general consultant, Mr. Tigges will have charge of the engineering of new products and new applications with reference to postwar plans. Since his graduation from Massachusetts Institute of Technology in 1923, with a degree of Bachelor of Science in Electrical Engineering, Mr. Tigges has been associated with the engineering firm of Jackson and Moreland, Boston.

William O. Wilson of Evanston, Ill., has been appointed Commercial Vice-President of Worthington Pump and Machinery Corp. of Harrison, N. J. In his new capacity, Mr. Wilson will be responsible for general supervision and direction of all of Worthington's commercial activities in the Chicago, St. Louis, Kansas City, and St. Paul District Office territories, with his headquarters at the Chicago District Office, 400 West Madison Street, Chicago.

Announcement has been made by the McCulloch Engineering Corp., Milwaukee, Wis., of the appointment of Donald A. Sutherland as field engineer in charge of sales and sales promotion activities. McCulloch, a division of Borg-Warner, manufactures superchargers and blower equipment. Mr. Sutherland is a graduate of the engineering school of the University of Minnesota. Before coming to McCulloch, he spent ten years with Fairbanks-Morse in St. Paul, in engineering work relative to the municipal and industrial markets for Diesel engines.

CLEANERS FOR TUBES

of every kind, size and shape

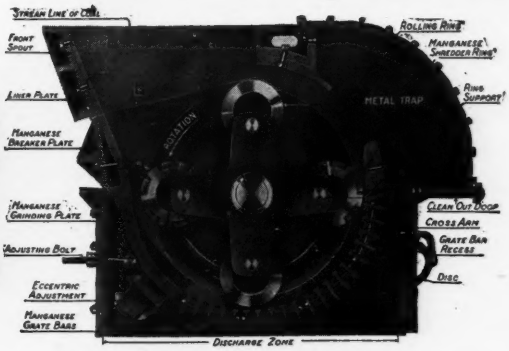
Wilson Tube Cleaners are made for straight tubes of every size and radius that can be cleaned mechanically. Cutter heads are available for every kind of scale or deposit from soft and powdery to thick, hard tube-plugging scales. Motors are driven by air, steam, water or electricity.

wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

WHY THE AMERICAN *Ring* CRUSHER WAY is the Economical way to better coal sizing

Lower Half of Crusher Showing Patented Shredder Rings and Eccentric for Adjusting Grinding Plate



Cross-sectional view of AMERICAN Ring Crusher

These features help reduce R.O.M. or Lump to proper combustion size in ONE operation

One of the surest and most economical ways to get the better coal sizing you need to reduce steam generating costs is to install AMERICAN *Ring* Crushers. They reduce in *one operation* run-of-mine or lump coal to the proper sizes for unit pulverizers and automatic stokers.

As shown in the views above, the "AMERICAN" differs from any other type of ring crusher. Feed entering the top is rolled by the rings in a downward movement against the breaker plate where primary reduction takes place. Final reduction is accomplished against an adjustable grinding plate where any oversize is eliminated by grate bars or screen plates.

The rotor in the "AMERICAN" consists of a heavy alloy steel main shaft to which are keyed steel discs and spiders or cross arms. The shafts supporting the rings are of high carbon steel and the rings are installed in staggered arrangement covering the entire grinding surface of the machine. The patented shredder rings *split* the coal rather than crush it.

Guaranteed Performance

The many successful installations of "AMERICANS" in industrial plants, central stations and service establishments of all kinds are the result of the thoroughness with which our engineers study individual plant requirements before making a recommendation. On the basis of our recommendations, "AMERICANS" are guaranteed for definite performance. Let us co-operate on your coal crusher problems.

Rings in the "AMERICAN" Ring Crusher—weighing 27 lb. each—are of manganese steel. These rings apply centrifugal force to strike, roll and grind.

LESS THAN 1c PER TON

The patented scraper and shredder rings of the "AMERICAN"—an exclusive feature—splits the coal and prevents clogging. The action of the rings in the "AMERICAN" is largely responsible for the low cost per ton of finished product. Coal can be crushed to stoker size at a total cost of less than 1c per ton for all charges.

AMERICAN PULVERIZER COMPANY 1429 Macklind Avenue St. Louis 10, Missouri

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

Vincent A. Sheals has been appointed Designing Engineer of the Cable Engineering Division of General Electric's Schenectady Works. W. C. Hayman, Mr. Sheals' predecessor, who has served in this position for many years, will be available as a general consultant. Mr. Sheals became affiliated with the company in September, 1921, following graduation from Union College. In 1923 he transferred to the general office as a cable engineer in the cable engineering division, Central Station Division, and in January, 1930, he joined the staff of the New York Office as district cable specialist. In 1939, Mr. Sheals returned to Schenectady as assistant designing engineer of the cable engineering division, a position he retained until his recent appointment.

C. A. Schroeder, of the Yale & Towne Manufacturing Co., has been appointed a member of the American Standards Association's Committee on Preferred Voltages of 100 and under. The committee's work consists of the formulation of a list of preferred voltages—100 v and under—for generation from any source and for distribution and utilization purposes. It excludes, however, secondary voltages in reduced voltage motor starters.

MANUFACTURERS' NEWS

Announcement has been made by the Belmont Packing & Rubber Co. of Philadelphia that Paul Reinking will be a company representative with headquarters in Dallas, Tex., and will cover the southeastern and south central territories as Service Engineer. Mr. Reinking is a graduate of Coe College, Cedar Rapids, Iowa, and has built up an enviable reputation during the fourteen years he has worked with and through distributors on the sale of industrial products.

On February 1, The Brown Instrument Co., Philadelphia, Pa., started a new industrial instrument maintenance and repair course. Changes have been made in the general outline of the course, especially that having to do with instructions in the two types of potentiometers, mechanical and electronic. The two types will be treated as separate subjects to make it easier for students to absorb the basic principles of each, and to meet the requirements of those instrument users who send students to the school for the specific purpose of receiving continuous balance instrument instruction. The new classes will extend to April 26. The instruments studied will be millivoltmeter type pyrometers, mechanical potentiometer type potentiometers, continuous balance (electronic) potentiometers, electrically operated automatic control, flow meters, thermometers, pressure gages and hygrometers, air-operated automatic control, and resistance thermometers and tachometers.

Machlett Laboratories, Inc., Norwalk, Conn., announces the appointment of Henry J. Hoffman as Sales Manager of the Power Tube Division, as well as Administrative Assistant to Miles Pennybacker, Vice President. After receiving his degree as electrical engineer, followed by two years as an engineer with the General Electric Co., Hoffman joined Westinghouse Electric & Mfg. Co. in 1926. In 1932 he was appointed manager of electronic tube sales and in 1937 became general manager of the company's Special Products Division. He has been active in the industry's trade associations and served as chairman of the industry's Code Committee under NRA. At present he is chairman of the Electronics Division of the National Electrical Manufacturers Association.

Burgess-Manning Co. was incorporated January 26, 1944, and, as a subsidiary of Burgess Battery Co. assumed the activities of the Acoustic Division of Burgess Battery Co. on January 31. The newly elected officers are W. L. Manning, President; D. W. Day and R. L. Leadbetter, Vice Presidents; J. E. Lutz, Treasurer; H. H. Darbo, Secretary; E. D. Woisard, Assistant Treasurer and Assistant Secretary. Offices will be located at 2815 West Roscoe Street, Chicago, 18, Ill.

George E. Sanford, in charge of the Company's safety program reports that since the last fatality in the Schenectady Works of the General Electric Co. more than two years ago, the plant has worked 211,124,832 man-hours. This is believed to be an unequalled record for a factory manufacturing heavy machinery. Close to this record, however, is the Fort Wayne, Ind. Works with 200,272,098 man-hours since its last fatality.

Belting made with the new synthetic rubber from government plants, known as GR-S synthetic rubber can be joined to natural rubber belting

RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE—Hazle Brook Premium . . . Raven Run

Our personnel with the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

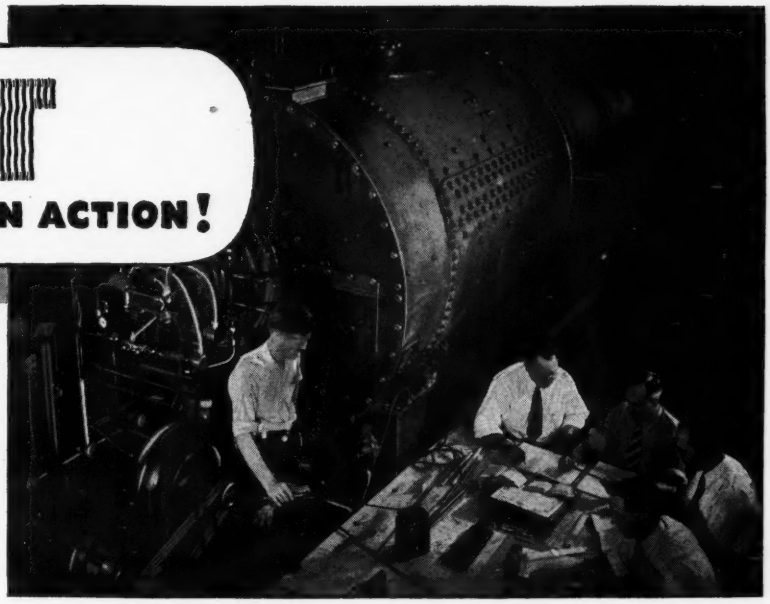
GENERAL COAL COMPANY

123 SOUTH BROAD STREET — PHILADELPHIA, PA.

BRANCHES:

BLUEFIELD, W. VA. — BOSTON — BUFFALO — CHARLESTON — CHARLOTTE, N. C.
CINCINNATI — DETROIT — NEW YORK — NORFOLK — PITTSBURGH

HEAT CLINIC IN ACTION!



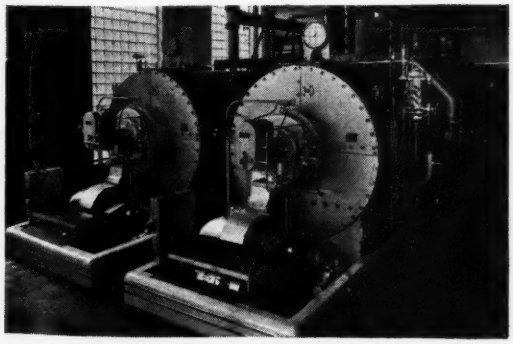
....THESE MEN ARE DECIDING HOW MUCH — FROM HOW LITTLE

THE engineers shown above are carrying on exacting tests to see how much usable heat they can squeeze from the least amount of fuel-oil—in other words—thermal efficiency.

The machine is a fully assembled Cleaver-Brooks steam generator, undergoing a performance test before shipment.

In the field and "on the job" Cleaver-Brooks steam generators have been put to test in scores of essential war industries, and at advance naval and army base locations where unfailing dependability is vital and "mechanical trouble headaches are out." In remote regions on the very edge of America's military ring of protection Cleaver-Brooks Steam Generators are delivering the dependable service for which they were chosen.

Quick steaming capacity—high thermal efficiency (not less than 80% guaranteed)—their minimum manpower requirements in operation and maintenance—their simple, low-cost installation—their dependable 'round-the-clock performance—these are but a few of their many advantages that have given them a definite "edge" wherever low-cost steam is needed.



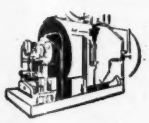
Showing two 300 HP. Cleaver-Brooks Steam Generators as installed at the Downing Box Co., Milwaukee. Note compactness and entire absence of breeching and feed-water piping—all piping concealed in pits below floor level.

Get full information now—for the future—on Cleaver-Brooks oil-fired steam generators—sizes 20 to 500 H.P.; pressures 15 to 200 lbs.

CLEAVER-BROOKS COMPANY
5136 North 33rd Street • Milwaukee 9, Wisconsin

Cleaver-Brooks STEAM GENERATORS

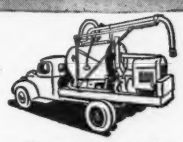
CLEAVER-BROOKS PRODUCTS INCLUDE:



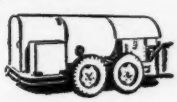
Steam Generators

Food Processing Equipment

Tank Car Heaters



Bituminous Boosters

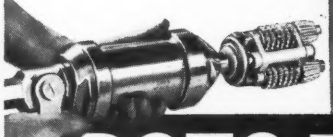


Special Military Equipment

Do your men clean the FRONT ends of tubes?

With ordinary tube cleaners, cleaning the front ends of tubes is a dangerous operation, even with perfect coordination between operator and helper. There is a natural tendency to insert the cleaner far enough inside the tube to eliminate any danger from revolving cutters when the air is turned on, thus leaving the front ends of tubes uncleaned.

With a Roto Tube Cleaner equipped with air valve directly behind the motor, the operator himself turns the air on and off. This positive one-man control permits him to turn on as much air as he needs, whenever he needs it, and he can clean right up to the end of the tube with complete safety. Get details of these time- and labor-saving tube cleaners.



ROTO Tube Cleaners

The ROTO Company, 145 Sussex Ave., Newark 1, N. J.

WHEN YOU WRITE TO ADVERTISERS

When writing advertisers for catalogs, descriptive bulletins or prices, please remember to say, "I saw your message in POWER PLANT ENGINEERING." Thus you'll do a good turn for the advertiser and for this publication. . . .

with a vulcanized splice, it is announced by The B. F. Goodrich Co. This makes it possible to use sections of the new GR-S synthetic belting to repair existing belting when needed. The company's standard splicing and repair materials can be used with the new GR-S synthetic belting, using the same directions given in the B. F. Goodrich manual on repairing and splicing belting.

The Stoker Manufacturers Ass'n Executive Committee announces that the annual meeting of the Association this year will be held at French Lick Springs, Ind., on Thursday and Friday, June 1 and 2. President McClintock will announce the names of appointments to the Annual Meeting Committee shortly and further details will be available as arrangements are made.

NEWS FROM THE FIELD

Allan E. Hall

ALLAN E. HALL, manager of the milling machinery department of Allis-Chalmers Mfg. Co., Milwaukee, Wis. died January 17 after an illness of several months.

Mr. Hall, who was 70 years old, has headed the milling machinery department since 1920. He joined Allis-Chalmers in 1909, when he was stationed at the Seattle district office, and in 1911 he entered the milling machinery department in Milwaukee. This department, which formerly handled only flour and saw mill equipment, has since 1925 included the multiple V-belt power transmission section of the company, which handles the Texrope line.

Mr. Hall was born at Parkers Landing, Penn. He attended Pennsylvania State college and Yale university, from which he received his bachelor of philosophy degree in 1895.

From 1895 to 1906 he was employed at the William H. Jenks Foundry and Machine Shop, Brookville, Penn., and from 1906 until his employment by Allis-Chalmers in 1909, by the Puget Sound Machinery depot, Seattle.

Herbert Hoover, while secretary of commerce, appointed him to the national committee for wood utilization representing the ASME.

Restrictions Lifted on Copper and Copper Base Alloys

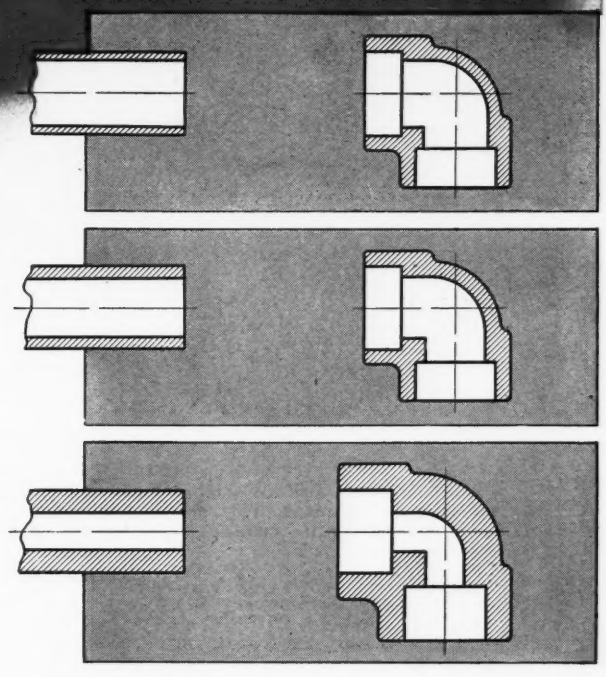
RESTRICTIONS on the use of copper and copper base alloys which have limited the inclusion of these metals in the manufacture of tube and tube sheets of steam condensers, have been lifted, according to an announcement made February 21 by the War Production Board. This action will lengthen the average useful life of condenser tubes and sheets and to a large extent eliminate costly shutdowns of installations using this type of equipment due to failure of parts made with substitutes such as steel. The use of copper will also reduce the quantities of replacement and maintenance parts made necessary by the unsatisfactory performances of alternate materials.

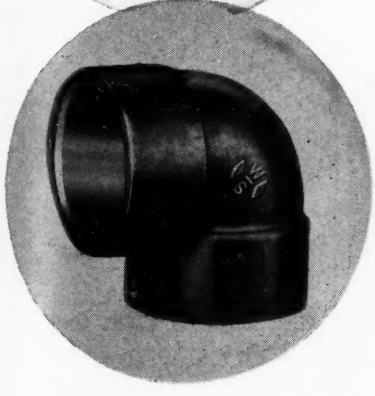
W·S Socket Welding Fittings for

STANDARD PIPE
(Schedule 40)

EXTRA HEAVY PIPE
(Schedule 80)

DOUBLE EXTRA HEAVY PIPE





Available for use with any weight steel pipe up to 4" nominal pipe size. Types: 90° Ells — Tees — 45° Ells — Crosses — Couplings — Reducers — Sleeves — Caps — Unions.

Can also be furnished in Carbon-Molybdenum Steel, and to United States Navy Department Specifications.

Send for Bulletin A-3 giving complete details, specifications and engineering data for all Watson-Stillman Fittings including a complete line of screw end Forged Steel Fittings.

W-S Forged Steel Socket Welding Fittings mean lower material cost and lower welding cost in the plants where they're used. Once installed, they assure low maintenance cost, also.

Check these features: Simple to use. Can be slippd over the pipe and welded. Deep sockets support pipe, no special fixtures being required to hold or line up the joint. No tack welding is necessary.

Position of weld prevents formation of welding icicles, removing the danger of clogged lines. Wall thickness is uniform — 1¼ times the wall thickness of the pipe. Fittings have same inside diameter as the pipe, assuring smooth uninterrupted flow. The Watson-Stillman Co., Roselle, N. J.

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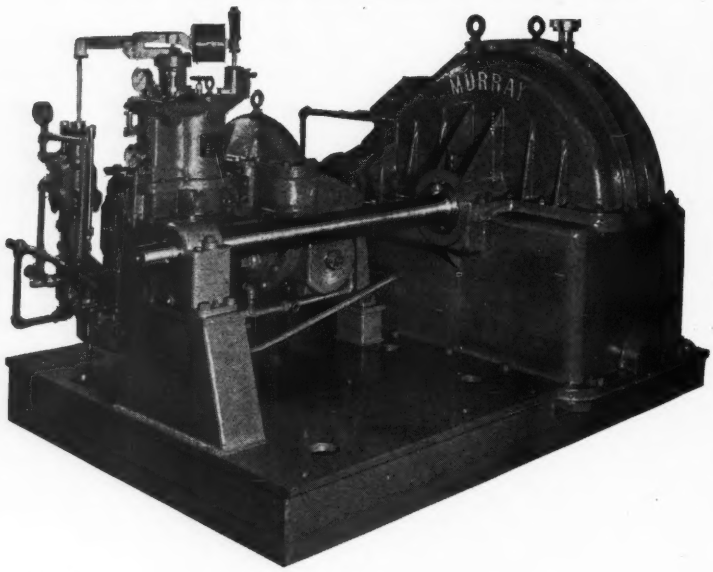

EACH MURRAY Turbine shipped from this organization is consigned to a war plant. That is our production schedule for the duration. Our entire facilities are devoted to meeting high priority needs.

Even though you may not have a rating that entitles you to purchase a MURRAY Turbine now, it will pay you to investigate. Find out the advantages MURRAY design and construction offer. When the time comes that restrictions in deliveries are lifted, you will have an answer all ready for your turbine needs.

The same applies for MURRAY Boilers and Engines. Write today for descriptive bulletins.

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BURLINGTON IOWA

BACK THE ATTACK

WITH WAR BONDS

Output of Hydroelectric Power Doubled

THE U. S. DEPARTMENT OF THE INTERIOR in its report for the 1943 fiscal year states that it doubled its output of hydroelectric power, increased its power-producing capacity by nearly half a million kilowatts, and more than doubled its delivery of power to war industries.

Fuel Efficiency Engineers Appointed

JOHN G. MINGLE, of the U. S. Bureau of Mines, has been appointed district engineer by Dr. R. R. Sayers, director of the bureau, and assigned to Indianapolis, Ind., from where he will supervise the Government's fuel efficiency program in Michigan, Ohio, Kentucky, and Indiana. The new coordinators, also named by Dr. Sayers, and their headquarters cities are Merrill F. Blankin, president of the American Society of Heating and Ventilating Engineers, Philadelphia, Pa.; Edward L. Crosby, of the Henry Adams Co., Baltimore, Md.; P. W. Thompson, vice president in charge of engineering for the Detroit Edison Co., Detroit, Mich.; William G. Christy, smoke abatement engineer for the Hudson County Board of Health and Vital Statistics, Jersey City, N. J.; Sam Dalton, of the Dalton Coal and Material Co., Columbia, Mo.; F. K. Prosser, coal traffic manager for the Norfolk & Western Railway Co., Roanoke, Va.; Albert L. Maillard, of the Military Chemical Works, Inc., Pittsburg, Kan.; and Linn Helander, head of the mechanical engineering department, Kansas State College, Manhattan, Kan.

Fire Destroys Engine Plant

ON FEBRUARY 2 fire destroyed the Portland, Ore., plant of the Industrial Division of the Iron Fireman Manufacturing Co. The loss was estimated at $2,000,000. This plant has been producing engines for Liberty ships for the past two years. It had received the coveted "M" award and its first gold star from the Maritime Commission for its outstanding work.

In the destruction were 24 Liberty ship engines, four complete and others in various stages of construction. A completed engine has a value of slightly less than $100,000. The company still has 79 Liberty engines to deliver under contract.

The cause of the fire was not immediately determined. Acetylene tanks in the plant exploded at intervals as the flames spread. Although 400 swing-shift employes were on the job when the fire broke out, there was no known loss of life. Employes at the plant numbered 1245.

Iron Fireman opened this plant in February, 1942, to produce Liberty ship engines. It had delivered 358 engines prior to the fire. The plant was delivering an average of an engine a day.

Manpower Quotas Met by Merchant Marine

OFFICIALS of the War Shipping Administration (WSA) have reported that for the first time since the beginning of the war, the quotas for experienced unlicensed engine department personnel in the Merchant Marine have been met.

These ratings include oilers, wipers, firemen-watertenders and other essential personnel in the power plants of our

All these FIRE-CLAY Tubes Have Been Used In Thermix Ceramic Dust Collectors

INDIVIDUAL PRECIPITATING TUBE ASSEMBLY

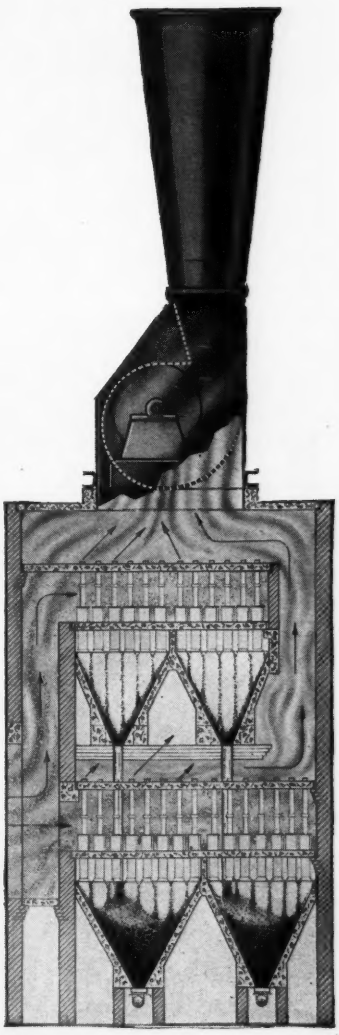
Industry has been quick to recognize the advantage of Thermix Dust Collectors with *ceramic,* instead of *steel,* tubes—not only because of the critical materials these ceramic tubes save but also because delivery can be made quickly and without a priority.

These practically indestructible ceramic tubes are harder than steel and they weigh no more per tube. Neither high temperature gases, nor corrosive low temperature gases containing sulphur, affect these fire-clay tubes.

Another thing . . . Thermix Ceramic Dust Collectors can be installed outside of the plant, if desired, without a protecting structure.

The design of the tubular dust collector constructed of non-priority material is basically identical with the Thermix Steel Dust Collectors now collecting fine dusts, powders and fly-ash in connection with 40,000,000 lbs. of steam capacity per hour.

DOUBLE-DECK ARRANGEMENT



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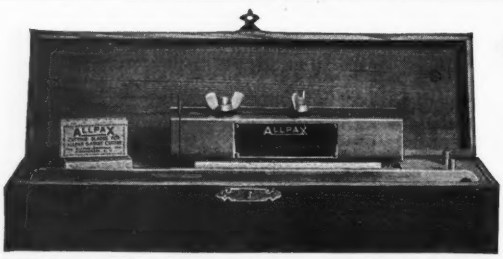

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Distributors everywhere *Mamaroneck, N. Y.*

Liberty ships, tankers and Army Transport Service vessels that constitute the lifeline to our troops abroad.

Recruitment and Manning Organization (RMO) of WSA has announced that recruitment of unlicensed engine department personnel has now been eased temporarily. Qualified men who declare themselves available for sea duty are for the immediate present being asked to remain on their jobs on call for the Merchant Marine, so that their services need not be lost to other industries while they are waiting temporarily for assignments. It was stated that recruitment in those ratings would again be necessary whenever Allied military needs changed markedly.

Safety and Relief Valves

ACCORDING TO AN ANNOUNCEMENT by the Division of Simplified Practice, National Bureau of Standards, a Simplified Practice Recommendation for Bronze Pop Safety Valves, and Bronze, Iron, and Steel Relief Valves, has been approved for promulgation. It became effective from February 1, 1944, and is identified as "R204-44."

The recommendation includes bronze pop safety valves, and bronze, iron, and steel relief valves suitable for steam, oil, water, air, and gas in industrial service, and for marine service where applicable. The simplified list will satisfy 95 per cent of the demand for these valves.

Pending printing, a limited number of mimeographed copies of this simplified practice recommendation will be available and may be obtained upon request to the Division of Simplified Practice, National Bureau of Standards, Washington 25, D. C.

Coal Selection Sheets

NATIONAL ASSOCIATION OF PURCHASING AGENTS, 11 Park Place, New York, N. Y., has just issued a set of forms for collecting information to be used in the selecting of coal for steam boiler plants. These include all of the items connected with the boiler plant which have bearing on this subject, arranged in a convenient manner, and are the result of an extensive study made by the Association's Coal Committee.

Most of the items covered have been used for selecting coal, but this is believed to be the first standard arrangement that can be used by the combustion engineer and the coal buyer, bringing them into complete understanding of each other and making it more possible for all boiler plants throughout the country to be surveyed for these characteristics.

Two of these forms contain the information that changes only when the equipment is changed and need therefore to be filled in only once for any particular equipment or layout. A third form covers information that should be collected periodically, at least once a year. The fourth form is the active one and should be filled in frequently, especially when changing coals. Form V is a simplified manner of reporting a coal trial.

These forms will be made available to anyone who cares to use them.

C. E. MacQuigg Honored

CHARLES ELLISON MACQUIGG, Dean of engineering at Ohio State University, was given the James Turner Morehead Medal of the International Acetylene Association at a dinner in his honor January 24, in New York, for "advancing the oxy-acetylene processes through

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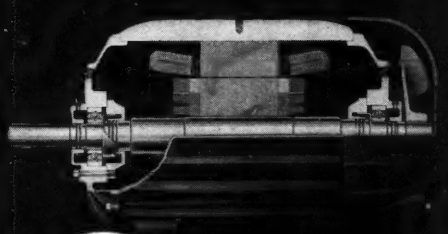

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SEALEDPOWER
(Cowl-cooled) . . . available for all polyphase alternating current circuits, 2 to 15 horsepower. Write for detailed literature, or call our nearest office.

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Now a Corrosion-Resistant *SEALEDPOWER* Motor

PROTECTED AGAINST: acid fumes, alkali fumes, splashing or dripping corrosive liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, etc.

PROTECTED BY: a corrosion-resistant frame, cooled by a built-in corrosion-resistant fan. The windings are *doubly* protected from damage by Crocker-Wheeler's vacuum-impregnation process which seals *each* coil individually against moisture, fumes or dirt.

BRUTALLY TESTED! The seal's effectiveness is proved by laboratory tests (at right) and by hundreds of satisfactory installations.

1 **SEALEDPOWER** motor was placed in tank containing several inches of water and run continuously for 8 hours (see photo). It stood idle in water overnight, then was run 8 more hours. During motor's operation, the external ventilating fan drenched the outside of the frame with water. At end of test, the motor was disassembled and found to be *completely dry* inside.

2 A dense atmosphere of extremely fine French chalk was kept circulating around the motor and through its ventilating system for many hours. No trace of chalk was found inside upon disassembly.

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metallurgical research, and for leadership in welding engineering education." The Morehead Medal is awarded annually by the International Acetylene Association in recognition of outstanding work in the acetylene industry or for advancements in the production or use of calcium carbide. The medal is awarded in honor of the late James Turner Morehead, who sponsored the experiments which led to the discovery, in 1892, of the modern electric-furnace method of producing calcium carbide, from which the acetylene industry has sprung.

Midwest Power Conference Program

COMPLETION of the preliminary program for the Midwest Power Conference to be held in the Palmer House, Chicago, has been announced by Stanton E. Winston, director. This meeting, which is sponsored by universities and engineering colleges of the Midwest, will take place on April 13 and 14 and is planned especially for power engineers with the purpose of providing them with information on the latest developments in the field and advanced maintenance practices. The preliminary program follows:

Thursday, April 13, 1944, 10:15 a. m. Open Meeting, H. B. Dirks, Chairman; Address of Welcome, Robert B. Harper, Vice President, Peoples Gas Light and Coke Co., Chicago; Response for the Cooperating Institutions, F. M. Dawson, Dean, College of Engineering, State University of Iowa; Postwar Planning of the Nation's Power Supply, Alex D. Bailey, Assistant to the Vice President, Commonwealth Edison Co., Chicago.

12:15 p. m. Joint Luncheon with ASME, J. P. Magos, Chairman; speaker, C. O. Dohrenwend, Chairman, Engineering Mechanics Research, Armour Research Foundation, Chicago, "Review of Experimental Stress Analysis Methods."

2:00 p. m. Central Station Practice. R. K. Behr, Chairman. (Sponsored and arranged by the Power and Fuels Division, Chicago Section, ASME); Progress towards Standardization of Turbogenerators for Central Station Service, M. S. Oldacre, Equipment and Research Engineer, Commonwealth Edison Co., Chicago; Causes and Prevention of Boiler Priming and Solids Carryover, W. H. Rowand, Engineer, Babcock & Wilcox Co., New York.

3:45 p. m. Plant Maintenance. H. L. Solberg, Chairman; Maintenance Systems, W. A. Perry, Superintendent, Electric and Power Departments, Inland Steel Co., East Chicago, Indiana; Corrosion Problems, L. G. Vande Bogart, Research Engineer, Research and Development Laboratories, Crane Co., Chicago.

3:45 p. m. Electrical Session No. 1. J. E. Hobson, Chairman; Studies of Generator Armature Insulation Deterioration, F. J. Pohnan, Senior Testing Engineer, Commonwealth Edison Co., Chicago; Temperature Deterioration of Solid Insulation in Oil, F. J. Vogel, Professor of Electrical Engineering, Illinois Institute of Technology.

6:45 p. m. "All Engineers" Dinner; Toastmaster: H. B. Gear, Vice President, Commonwealth Edison Co., Chicago; Speaker: J. A. Krug, Director of War Utilities, War Production Board, Washington, D. C.

Friday, April 14, 9:00 a. m. Industrial Power Plants. Hugh E. Keeler, Chairman; Application of Electronics to

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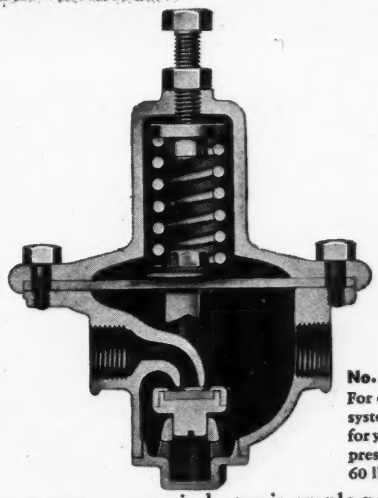
Prevent scale, dirt, chips, etc. from damaging regulator, traps, valves and pumps with Masoneilan strainers They eliminate maintenance delays and save money.



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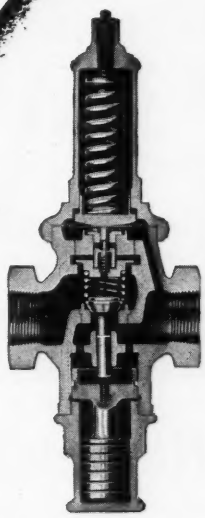

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Amt. in form of Glucosate	Amt. as dichromate	Application	Saving
	SODIUM BICHROMATE		
17 pounds	100 pounds	Calcium Brine	83 lbs.
17 pounds	200 pounds	Salt Brine	183 lbs.
34 pounds	500 pounds	Cooling Water	466 lbs.
	CHROMIC ACID		
3 pounds	66 pounds	Calcium Brine	63 lbs.
3 pounds	132 pounds	Salt Brine	129 lbs.
10 pounds	330 pounds	Cooling Water	320 lbs.

Help us to stop the waste of chromium ore. Switch to Chrom Glucosate at once and tell your business acquaintances the story of Chrom Glucosate too.

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Power Generation, J. D. Ryder, Assistant Professor of Electrical Engineering, Iowa State College; Inhibitors in Condenser Tube Alloys, Austin R. Zender, General Sales Director, Bridgeport Brass Co., Bridgeport, Conn.

10:30 a. m. Fuels, R. E. Summers, Chairman; Research in Fuels as a Postwar Necessity, A. R. Mumford, Development and Research Department, Combustion Engineering Co., New York; Postwar Outlook for Oil Fuels, Arch L. Foster, Refinery Editor, The Oil and Gas Journal, Tulsa, Okla.; Statistical Comparison of Fuels, C. C. DeWitt, Chairman, Department of Chemical and Metallurgical Engineering, Michigan State College.

10:30 a. m. Electrical Session No. 2. R. W. Jones, Chairman; Developments in the Field of Control, E. H. Alexander, Engineer, Industrial Control Division, Industrial Engineering Department, General Electric Co., Schenectady; New Applications of Mercury Arc Rectifiers, W. E. Gutzwiller, Engineer in charge of Rectifier Application, Allis-Chalmers Manufacturing Co., Milwaukee.

12:15 p. m. Joint Luncheon with AIEE. F. E. Keith, Chairman; Speaker: B. W. Clark, Vice President in charge of Sales, Westinghouse Electric and Mfg. Co., East Pittsburgh, "Tomorrow's Outlook."

2:00 p. m. Electrical Session No. 3. L. B. Les Vesconte, Chairman (Sponsored and arranged by the Power Group, Chicago Section, AIEE); Trends in Power System Analysis, Miss Edith Clarke, Central Station Engineer, General Electric Co., Schenectady; Ice Melting Practice on 132-kv Lines, H. A. Cornelius, Senior Engineer, Public Service Co. of Northern Illinois, Chicago; Visualizing Heat, Magnetic, and Electrostatic Field Problems in Electrical Apparatus, J. F. Calvert, Chairman, Department of Electrical Engineering, Northwestern University.

3:45 p. m. Diesel Power. M. P. Cleghorn, Chairman; Closed Evaporative Coolers, William Goodman, Consulting Engineer, Trane Co., La Crosse, Wis.; Isolation of Vibration from Diesel Plants, H. H. Fink, Product Design Engineer, The B. F. Goodrich Co., Akron, Ohio.

U. S. Navy Needs Engine Type Specialist Officers

A NEW FIELD of specialized Naval duty, known as Engine Type Specialist Officer, has just been opened for procurement. Men who are accepted for it will receive commissioned rank, and after special training will see interesting and varied duty.

The new billet requires experience in the manufacturing, installation and service of internal combustion engines, or electrical machinery (both a-c and d-c), or steam turbines, or reciprocating steam engines.

To qualify for a commission, the applicant must have either a degree from an accredited college plus at least five years of appropriate experience, or, in the absence of a degree, at least ten years of appropriate experience. Candidates should not be currently employed in essential war work or employed by a Federal Agency.

Experience familiarizing the applicant with machinery actually in use in the Navy is desirable although not a prerequisite.

The age limits for this program are

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Acts Instantly, Dependably—is the only control that detects flame failure entirely by direct observation of the flame itself. All other control methods rely wholly or partly on temperature, electrical conductivity or other indirect and, therefore, less positive flame characteristics.

Provides Completely Automatic Control—is used alone for control of manually ignited burners, to turn off both main and pilot valves and sound an alarm; or, when burner is automatically fired with Program Relay Type R25, to provide desired sequence of fuel pump and valve operation.

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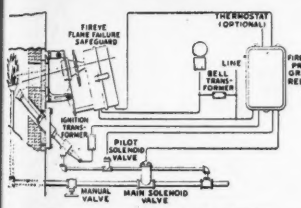

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Floatless . . . Maintenance-Free . . . Electronic

- Maintains Desired Water Level Automatically.
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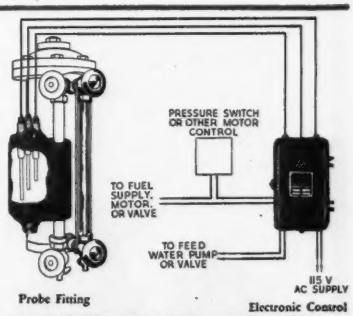
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TO FUEL SUPPLY, MOTOR, OR VALVE
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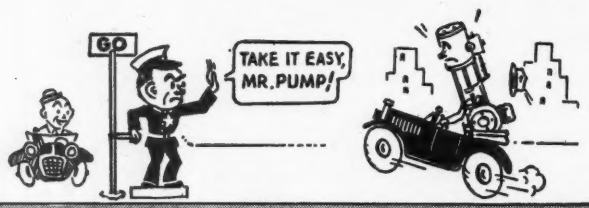


COMBINATION *Protect Pumps against wasteful "over-speeding"*

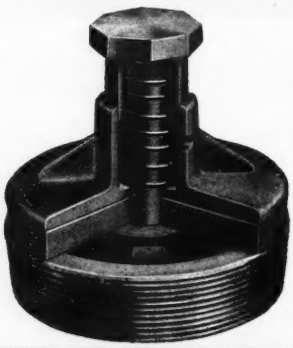
NON-TILT, NON-SLIP VALVES

The tilting action of some reciprocating pump valves causes the seat to wear unevenly—which means the pump has to work faster and faster to carry its load.

COMBINATION Pump Valves enable you to get theoretical capacity out of your pumps without racing and wasting valuable steam. They prevent tilting and consequent pump slippage because they lift straight. They save on repair bills, too, because their seat, stud and springs are made of long-wearing Phosphor Bronze.

These improved pump valves match the fine performance of COMBINATION Silent Check Valves. Ask for descriptive folder with dimensions, prices and further information.

For Boiler Feed Vacuum, Condenser General Service



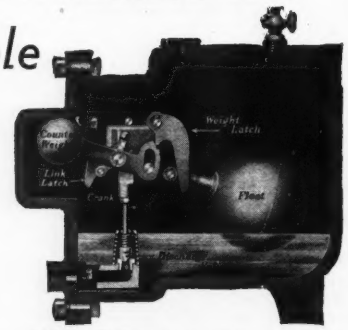
COMBINATION PUMP VALVE CO.

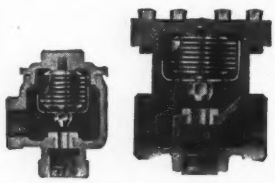
846 Wiota Street, Philadelphia, Pa.

NICHOLSON TRAPS

↑ *UP Production* BECAUSE THEY *DOWN Trouble* ↓

Many reports show that installations of Nicholson Traps have stepped up production of heated units as much as 30%. A size and type for every need.





Shown above are Types A (left) and B, two of five widely used Nicholson Thermostatic Industrial Traps; sizes ¼" to 2" for pressures to 225 lbs. All are proof against air-binding, freezing, dribbling, water-logging. Enormous water and air discharging capacity.

NICHOLSON
WEIGHT-OPERATED STEAM TRAP

A large-capacity trap for pressures to 1500 lbs. at 1000 degree maximum temperature. Positive automatic intermittent action. Quick opening and closing valve. Water-sealed discharge. Catalog No. 941 also shows Nicholson Piston-Operated and Compressed Air Traps.

Write for Trap Catalog 941.
See our Catalog in Sweet's.

Traps • Valves Steam Specialties **W. H. NICHOLSON & CO.** *160 Oregon St. Wilkes-Barre, Pa.*

24 through 49. The applicant must, of course, be qualified physically for Naval duty.

After receiving special training at Mechanicsburg, Pa., men chosen will see active duty in the servicing, maintenance and repair of internal combustion engines in operating vessels in advance areas.

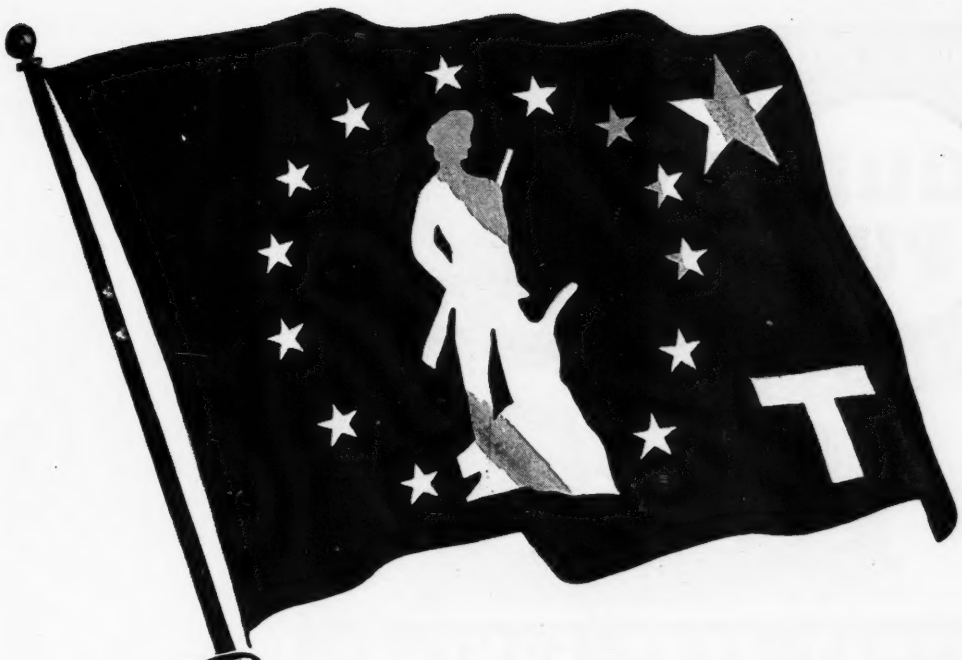
All persons interested should apply in person or by mail to the nearest of the following Offices of Naval Officer Procurement:

721-31 Healey Bldg., Atlanta 1, Ga.; University of South Carolina, Columbia 19, S. C.; 915 Lynch Bldg., Jacksonville 1, Fla.; Room 326, New Post Office Bldg., Knoxville 1, Tenn.; Room 905, Langford Bldg., 121 S. E. First St., Miami 32, Fla.; 203 Capital Club Bldg., Raleigh, N. C.; 150 Causeway St., Boston 14, Mass.; Board of Trade Bldg., 141 West Jackson Blvd., Chicago 4, Ill.; 9th Floor, Enquirer Bldg., 617 Vine St., Cincinnati 2, Ohio; 6th Floor, Marshall Bldg., 200 Superior Ave., Cleveland 13, Ohio; 208-218 Old Federal Bldg., 5th & Court Sts., Des Moines 9, Iowa; 9th Floor, Book Bldg., 1249 Washington Blvd., Detroit, 26, Mich.; 202 Finance Bldg., 1009 Baltimore Ave., Kansas City 6, Mo.; 110 East Wisconsin Ave., Milwaukee 2, Wisc.; 1645 Northwestern Bank Bldg., Minneapolis 2, Minn.; 210 North 13th St., 6th Floor, Missouri Pacific Bldg., St. Louis 3, Mo.; Title Guarantee & Trust Co. Bldg., 411 W. 5th St., Los Angeles 13, Calif.; Louisiana Bldg., 217-227 Camp St., New Orleans 12, La.; 601-609 Jackson Bldg., Birmingham 3, Ala.; 1530 Allen Bldg., Dallas 1, Texas; 824 Niels-Esperson Bldg., Houston 2, Texas; 1212 Sterick Bldg., Memphis 3, Tenn.; 805 APCO Tower, Oklahoma City 2, Okla.; 33 Pine St., New York 5, N. Y.; Genesee Valley Trust Bldg., Rochester 4, N. Y.; 17th Floor, Widener Bldg., Juniper & Chestnut Sts., Philadelphia 7, Pa.; Keystone Hotel Bldg., 3rd Ave. & Wood St., Pittsburgh 22, Pa.; Fifth & Cary Sts., Richmond 19, Va.; Kanawha Hotel Bldg., Charleston 1, W. Va.; 703 Market St., San Francisco 3, Calif.; 117 Marion St., Seattle 4, Wash.; 1233 American Bank Bldg., Portland 5, Ore.; 1320 G St., N. W., Washington 25, D. C.; Richmond Market Armory, N. Howard St., Baltimore 1, Md.

Oil and Gas Power Conference

THE 17TH NATIONAL Oil and Gas Power Conference which will be held at the Mayo Hotel, Tulsa, Oklahoma, May 8-10, will feature a timely and exceptionally interesting technical program.

The tentative program is planned for three days, with five technical sessions, one luncheon, a banquet and one period given over to inspection trips. The Monday session will include a paper on the present status of the gas turbine and another on recent developments in turbosupercharging. Tuesday's session will center around power-plant design and operation, featuring papers on gas-Diesel engines, exhaust systems and pipeline-plant operation and maintenance. Both sessions on Wednesday will be devoted to the problem of engine control and governing, with three papers on control for aircraft, railroad and marine engines, a paper on special problems of governing Diesel generators operating in parallel, and a paper on control of pipeline engines.



Congratulations

ON A FINE JOB, WELL DONE!

THE Treasury "Star" Flag—the bond-buying counterpart of the Army-Navy "E"—marks plants with at least 90% of personnel participating in the Payroll Savings Plan to at least 10% of gross payroll, *and also having reached, or topped, a War Loan Drive quota!*

The successful close of the 4th War Loan Drive finds many more "Star" Flags than ever before flying over the industrial plants of America. To all these, go the heartiest thanks of the nation, and the deep appreciation of the Treasury Department for a great job! And to those who may not quite have qualified for the "Star," go equally sincere thanks—and the confidence that soon they, too, will join the ranks of the "Star" fliers.

One thought that many concerns have found helpful in stepping up the intake from their Payroll Savings Plans is this. In many cases the Treasury Representative in a plant has been able to point out the fact that during *Loan Drive periods* the employees have found it possible to spare much more than they had counted on when setting up their original subscription, and that—*when properly approached*—a very substantial fraction of such employees will decide they can well afford a distinct increase in their current Payroll Savings Plan.

Talk this over with your Treasury Representative—it offers important possibilities when correctly handled. And again accept the Treasury Department's congratulations for your fine work in helping to put over the 4th War Loan.

LET'S ALL KEEP BACKING THE ATTACK WITH WAR BONDS

The Treasury Department acknowledges with appreciation the publication of this message by

POWER PLANT ENGINEERING

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council.

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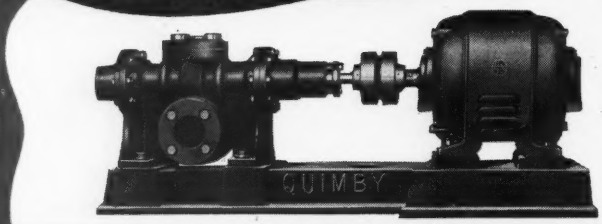
QUIMBY PUMPS

Quimby Pumps have a way of keeping everlastingly at it, without any sign of wear or letdown in efficiency, far beyond the usual life expectancy of a pump.

KEEP EVERLASTINGLY AT IT



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INCORPORATED
Division of H. K. Porter Company, Inc.
PITTSBURGH, PENNSYLVANIA
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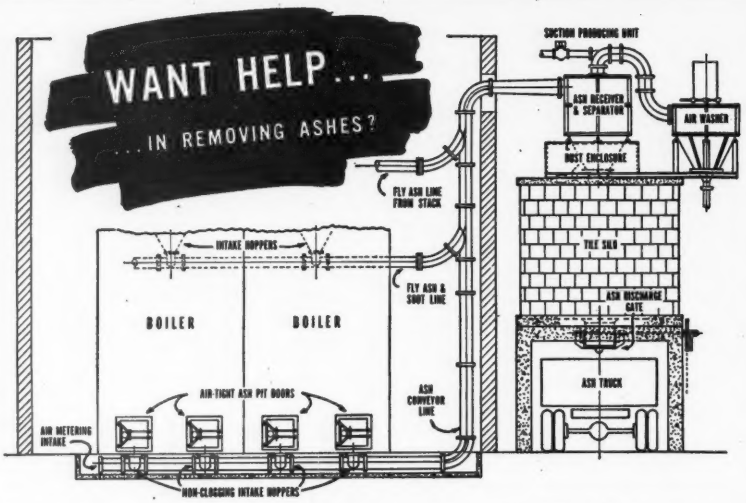
...IN REMOVING ASHES?



Get the help you need by installing a Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Labor is saved; cleanliness effected. System time-tested. Low first cost. Low operating cost. Installation as flexible as running a pipe line. Minimum critical materials required. Two sizes, two types—for delivering ashes either dry or damp.

For details — write!

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

The Tuesday evening session, to which all engineering groups in Tulsa will be invited, will include an unusual film and talk on aircraft maintenance, sponsored by one of the large airline companies.

Present plans for inspection trips include a visit to the maintenance shops of one of the large pipeline companies and possible visits to a bomber assembly plant and an oil refinery.

Langmuir Awarded Faraday Medal

DR. IRVING LANGMUIR, associate director of the General Electric Research Laboratory, has been awarded the Faraday Medal of the Institution of Electrical Engineers in London, according to a radiogram he has received from Stanley Angwin, president of the Institution.

The medal, one of the highest honors in its field, is given for world-wide services to electric science and engineering and was established in 1922. Since then it has been given to Oliver Heaviside, Sir J. J. Thomson, Lord Rutherford, Sir Oliver Lodge, and others. Dr. Langmuir is the fourth American to receive it. In 1927 it was given to Professor Elihu Thomson, one of the founders of the General Electric Co.; in 1935 to Dr. Frank B. Jewett, president of the Bell Telephone Laboratories; and in 1939 to Dr. William D. Coolidge, General Electric vice-president in charge of research.

Dr. Langmuir has received many other outstanding awards, chief among them being the Nobel Prize in 1932 for his work on the absorption and orientation of molecules at surfaces and the mechanism of gas reactions at the surface of tungsten. The latter was a theoretical piece of work that led to the development of the universally used gas-filled incandescent lamp. In 1917 he received the Hughes Medal of the Royal Society, in 1921 the Rumford Medal of the American Academy of Arts and Sciences, in 1928 the Perkin Medal of the American Section of the Society of Chemical Industries, the Franklin Medal of the Franklin Institute in 1934, and many others.

Eastern Shore Public Service Plans Expansion to Cost $1,725,000

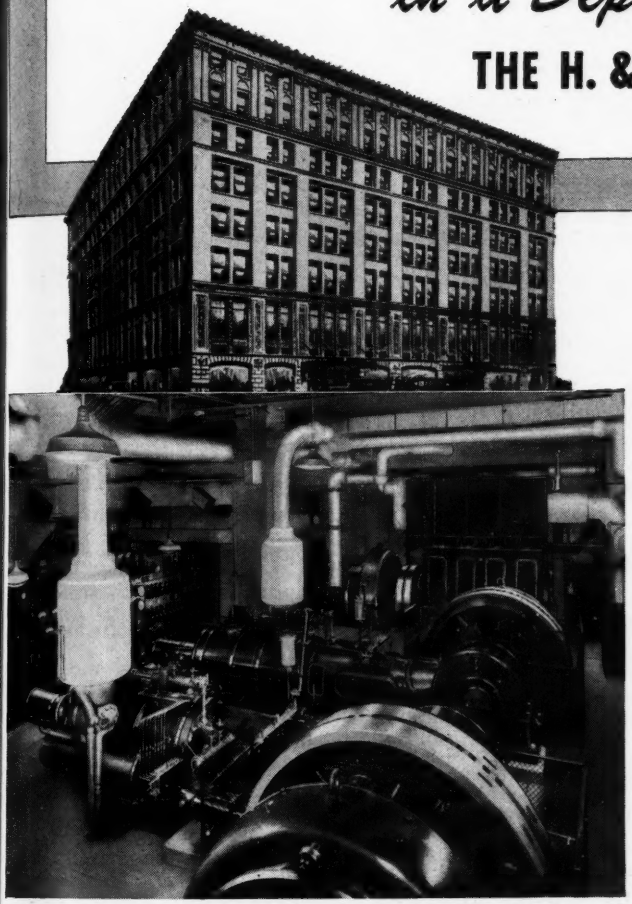
EASTERN SHORE PUBLIC SERVICE CO., Salisbury, Md., has authorized an expansion and improvement program in plants and system, to be carried out as soon as equipment and materials are available. Work will include addition to steam-electric generating station at Vienna, Md., with installation of a new 7500-kw turbine-generator unit and accessories, boiler, pumps and auxiliary equipment. Power substation at Cambridge, Md., will be enlarged, with installation of transformers, switchgear and accessory equipment. Similar substation expansion is planned at other points. Extensions will be made in transmission and distributing lines, extending service to other areas, with installation of operating facilities for consumer supply. Entire project is estimated to cost approximately $1,725,000, and fund in that amount has been authorized for program. It is understood that plans will be prepared and work supervised by Atlantic Utility Service Corp., 61 Broadway, New York, N. Y., which also acts as purchasing agent for company.

THE POWER PLANT...

A Profitable Department in a Department Store

THE H. & S. POGUE COMPANY

CINCINNATI, OHIO



PORTION OF THE POWER PLANT SHOWING THREE OF THE FOUR SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

WHEN the modern building program of this distinguished old department store was started in 1903, the far-sighted management installed four 100-kw. Skinner Steam Engine-Generators to produce electric power. Additions to the store and continued increase in electrical loads made it necessary eventually to replace these small units with four larger steam engines of the more modern Skinner "Universal Unaflow" type.

Exhaust steam at low pressure is used in winter for heating; and during the unusually long cooling season the exhaust is also employed at the same pressure for air conditioning.

Correct engine design and efficient attendance are reflected in the low maintenance cost in this plant. Combined with the permanently high economy of the engines and the maximum use of exhaust steam, these factors show a remarkably low cost of generated power. Thus the power plant has, for 40 years, proven itself to be one of the more profitable departments in this store.

Hundreds of similar cases, embracing almost every type of industry, have resulted in savings of millions of dollars by the installation of Skinner "Universal Unaflow" Steam Engines for generating economical, dependable electric power. Case studies in your particular industry will be sent upon request.

Some Users of "UNIVERSAL UNAFLOW" Engines

Hotels, Clubs	Food Products	Printing, Publishing
Schools and Colleges	Ice & Cold Storage	Paper, Paperboard
Hospitals, Homes	Mining	Laundries, Cleaners
Public Institutions	Chemical, Ordnance	Oil Refineries
Department Stores	Drugs and Soaps	Stone and Brick
Office Buildings	Machinery Mfrs.	Gas Plants
Railroads	Textiles	Rubber
Meat Packing	Leather Products	Glass
Dairies	Furniture & Woodworking	Bakeries
Breweries	Cotton Oil Mills, Gins	Tobacco
	Municipal Water & Electric Plants	

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Let's All Back The Attack—Buy More War Bonds

For Over 75 Years, Doing One Thing Well—Building Steam Engines

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TEMPERATURE and HUMIDITY
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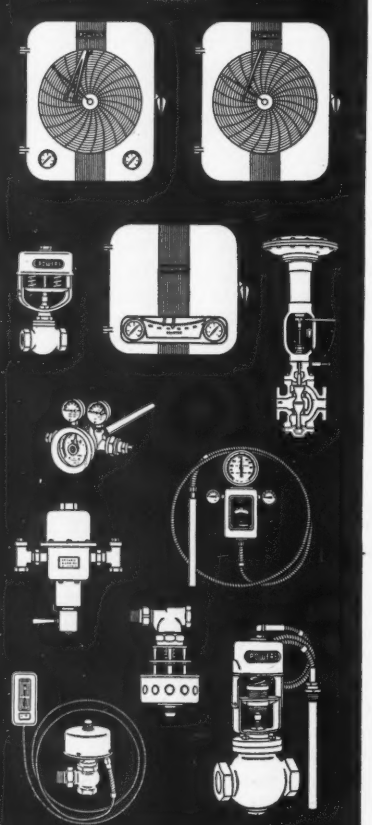

When you want accurate and dependable automatic temperature or humidity control for Industrial Processes, Heating or Air Conditioning Systems, call in a Powers engineer. With over 50 years of experience and a very complete line of self-operating and air operated controls we are well equipped to fill your requirements.

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Offices in 47 Cities—See your phone directory.

THE
POWERS REGULATOR CO.

Northwest Power Capacity to Total 4,000,000-kw in 1944

BY THE CLOSE of the present year, it is estimated that the total generating capacity of stations in the Northwest electric power pool will approximate 4,000,000-kw, as compared with about 3,000,000-kw rating at present time. Of this total, about 1,523,000-kw installed capacity is represented by privately-owned utilities, these including Puget Sound Power & Light Co., Seattle, Wash.; Washington Water Power Co., Spokane, Wash.; Portland General Electric Co., Northwestern Electric Co., and Pacific Power & Light Co., all of Portland, Ore.; Utah Power & Light Co., Salt Lake City; and Montana Power Co., Butte. With expansion now in progress, it is expected that this rating for private companies will be advanced to about 2,000,000-kw, within the next six to eight months. There are three important municipal power stations adding to this quota at Seattle and Tacoma, Wash., and Eugene, Ore., respectively. With a present combined rating of about 400,000-kw, expansion is under way at first two noted plants: Seattle is adding to its generating capacity by the Skagit hydroelectric power development, while Tacoma recently has resumed construction on Alder hydroelectric power station of its Second Nisqually municipal power project, following permission from WPB, with necessary priorities to complete this development. Installation will include a 25,000-kw hydraulic turbine-generating unit. Present installed capacity at Bonneville, Ore., and Grand Coulee, Wash., hydroelectric power stations of Government totals 1,080,000-kw, and with installation of new generating equipment at the latter plant, for which WPB recently removed prior restrictions, it is expected that total output of these two stations will be at least 1,300,000-kw in 1944. The Bonneville dam construction was completed last December, and the tenth and final generating unit, with rating of 74,000-hp, was placed in service, developing a gross capacity for this Columbia River station of 518,400-kw. Work on the power dam was begun in September 1938, with final completion 10 years and three months later. It represents a total investment of $81,360,000.

Mississippi Power Resumes Power Plant Construction

MISSISSIPPI POWER CO., Gulfport, Miss., is resuming construction of a new generating station on Leaf River, near Hattiesburg, Miss., as recently briefly noted in these columns, reviving a project initially included in the 1941 expansion program of company. WPB revoked priority ratings in August 1942, when construction was discontinued, and has now given approval, with necessary priorities for completion of project. New plant will be known as Eaton Station, and will have an initial installation of a 20,000-kw turbine-generating unit, high-pressure boilers and auxiliary equipment. Provision has been made for addition of two more generators of like rating in future. Orders for primary equipment were placed in the fall of 1941, and with resumption of construction, contracts for required auxiliary apparatus will be awarded at early date. Project will include a new transmission line to connect with present high-tension system of com-

XZIT

XZIT not only gets rid of soot and fire-scale from fire-box to top of stack, but checks further carbon deposits. This scientifically compounded chemical, which is fed into the fire-box while the unit remains in full operation, reduces the residual deposits of combustion in boilers, heaters and furnaces using all types of fuel.

Continued use of XZIT prevents further deposits, pitting and corrosion. The cost of XZIT is insignificant, compared with the time, labor and fuel it saves.

Send for details.

XZIT SALES CO.
1031 Clinton St., Hoboken, N. J.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

What is the Life Expectancy of Your Condenser Tubing?

Authoritative appraisal of sample tube lengths by Bridgeport technicians can result in effective steps to reduce corrosion rate.

Much praise has come to industry for its excellent war production achievement made possible only through fine team work. Probably the hardest hitting member of this team is the group of steam power plants whose slogan seemingly is "The impossible takes a little longer."

Since power plants are too modest to speak for themselves, it is up to each of us to recognize the outstanding job which they are doing. Handicapped by serious transportation difficulties, fuel and labor shortages, limitations in the choice of condenser tube alloys and other problems, they are called upon to deliver power and steam to industry in unbelievable amounts and 'round the clock. How they were able to keep up with the insatiable demand for power is a story which will be written after the war.

Overwork can bring disastrous results to power plants as well as to individuals. We are all familiar with the fate of executives who carry too great a burden and suddenly fall by the wayside. A similar catastrophe can befall a steam power plant whose condensers suddenly fail through overwork and resulting excessive corrosion. Many plants are no doubt much overloaded. They do not find the opportunity to clean the tubes as often as is necessary, consequently, the corrosion rate may be higher than usual. If they do not watch out, some of their condensers are apt to fail much sooner than expected. To forestall unexpected failures in men as well as in machines, it is advisable to have a frequent physical check-up. A number of plants are doing just this thing.

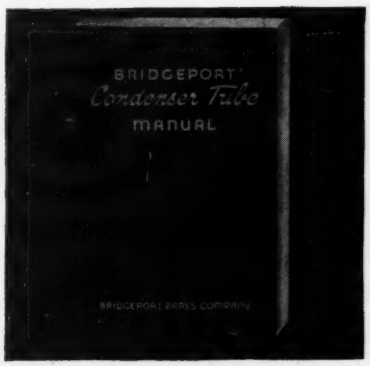
Our Laboratory receives frequent calls asking for advice as to how the life of tubes can be prolonged, in view of the shortage of strategic materials. We are glad to cooperate. Results obtained from these studies are mutually beneficial. In order to give an intelligent report as to the probable expectancy of the life of condenser tubes, we ask that two or three tubes be taken out of the condenser and sent to us. We do not mean little pieces but full lengths. The inlet and outlet ends as well as the top or bottom of each tube should be carefully marked for future identification. Our Laboratory can then study the whole tube from end to end and make its recommendations.

As you are no doubt aware, in many cases corrosion is localized to a certain portion or portions of the tube. Changing the operation of the condenser or protecting the corroded section of the tube may prolong its life appreciably. Data regarding the date when the tubes were installed; operating conditions, including temperature; circulating water speed; nature of the water; kind of alloy and other facts; are all necessary in helping to diagnose the seriousness of the corrosive attack.

The Laboratory is also in a position to suggest superior alloys which can be installed at some future time when restrictions are removed. Oftentimes the engineer can cooperate with the Laboratory by installing several lengths of special alloy tubes in order to obtain a service test under actual operating conditions. Such cooperation will some day bring about greater economy and lower maintenance of condenser tubes.

The marine field at the present time is in a more favorable position than the power plants as far as the selection of condenser tube alloys is concerned. While the land stations are limited to either Muntz or Admiralty, marine power plants are not limited and can use any alloys that are made. In the meantime, our Laboratory is accumulating more and more information on condenser tube alloys and their behavior under various conditions.

Considerable technical information has already been published in our new Condenser Tube Manual, which is available at no cost to engineers who request it. In addition to data on corrosion, we are listing the properties of the alloys which have been developed to give longer life. At the same time, it would be helpful to us if condenser tube users would contact us and tell us their experiences and problems. Requests for our new Condenser Tube Manual have exceeded all expectations. Fortunately we printed a sufficient quantity so that we are able to take care of additional calls. If you do not have a copy, drop us a line.



Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

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ARMY E NAVY

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VIKING

ENGINE *ALARM* SYSTEMS

TYPE M

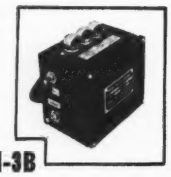
CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

COMPLETE ALARM SYSTEM



TYPE M-3B

Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thurmostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT

TYPE C

CONTACT MAKERS

Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

VIKING INSTRUMENTS, INC.

410 Fairfield Ave., Stamford, Conn. Telephone 4-7475

pany, with switching station, power substations and other operating facilities. Cost of entire project is estimated in excess of $2,000,000. Station has been designed by Engineering Department of Commonwealth & Southern Corp., Birmingham, Ala., of which the Mississippi company is a subsidiary. L. P. Sweatt is vice-president and general manager.

Industrial Alcohol Project in Oregon to Cost $3,600,000

Wood Chemical Co., Eugene, Ore., has been organized by Charles Snellstrom, president, Snellstrom Lumber Co., Eugene, and associates, to succeed to Willamette Valley Wood Distillation Co., chartered a few months ago, to construct and operate a plant for production of industrial alcohol from wood waste and sawdust. Plans for project are now maturing. A 30-acre tract of land is being acquired at Springfield, Ore., and financing arrangements consummated with Government. Plant will comprise several large one and multi-story processing and production buildings, with auxiliary structures for storage, distribution and miscellaneous service; also power plant, pumping station, machine shop, office and laboratory structures. Plant will operate under a new process and will be the first of its kind in country. It is estimated to cost $3,600,000, with Federal financing, noted, through Defense Plant Corp., Washington, D. C., Federal agency. Selection of site has been under direction of Smith, Hinchman & Grylls, Inc., Marquette Bldg., Detroit, Mich., architect and engineer, and it is understood that plans for plant will be prepared by that organization. Others interested in company include Fred M. Brenne, secretary, Eugene Chamber of Commerce; and H. J. Cox, secretary-manager, Willamette Valley Lumbermen's Association, both Eugene. Entire output of plant will be used by Government.

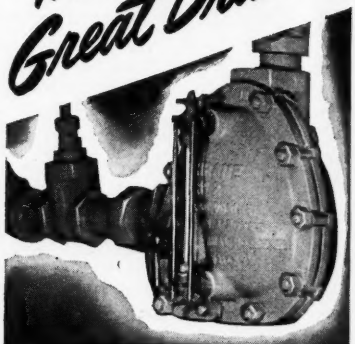
NEW ENGINEERING BOOKS

Patent Law. By Chester H. Biesterfield. Size 5½ by 8½ in.; 225 pp; cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $2.75.

This book is the outgrowth of a series of lectures on the substantive patent law, given as an extension course for graduate and undergraduate students at the University of Delaware in 1941 and 1942. The course was designed primarily for chemists, engineers, and students who desired to acquire an understanding of the subject.

In presenting the various phases of the patent law, the author has endeavored to explain the basic principle or rule underlying the subject under discussion, and illustrate by the citation of leading cases and quotation of pertinent sections. The book should be extremely valuable for engineers and others who do not possess a professional training in law, yet have frequent occasion to acquire detailed understanding of some proposition of

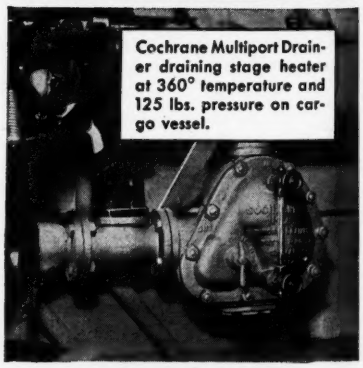
Tribute to a Great Drainer



"These traps" (Cochrane Multiport Drainers) "discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

—Steam Engineer of large New England paper mill.

Two Cochrane Multiport Drainers handle condensate returns for process, in a large southern printing plant.



Cochrane Multiport Drainer draining stage heater at 360° temperature and 125 lbs. pressure on cargo vessel.

Write for a copy of Publication 2925.

COCHRANE CORPORATION

3123 N. 17th Street, Philadelphia 32, Pa.

COCHRANE DRAINERS

Compressed **Air** *for automatic control*

The increasing application of pneumatic control is recognition of its many advantages—reliability, simplicity, safety, and ease of maintenance. Automatic pneumatic control is one of the cornerstones of continuous processes, and without it many process industries could not operate.

Here is another striking example of the utility of compressed air power. It may suggest to you a means of solving many of your problems by applying air—the power medium for countless jobs which cannot be done as well, if at all, by any other method.

Ingersoll-Rand has pioneered compressed air systems since 1871, always supporting and developing new and time-saving applications. Our engineers will be glad to cooperate with you. Ingersoll-Rand Co., 11 Broadway, New York, N.Y.

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Your Blueprint for

MORE POWER

starts with

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the patent law in connection with their work. For example, engineers often ask about the legal phases of invention or development work performed by employees of an industrial organization or about questions of assignment and licensing or about infringement of patents on existing equipment.

They will find much information in this book on these subjects as well as on priority of invention, originality, abandonment, patentability of uses, double patenting, reissues, infringement, trade secrets, patent litigation, and searches.

Thermodynamics. By J. E. Emswiler. Revised by F. L. Schwartz. Size 5½ by 8½ in.; 335 pp; cloth bound. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Price $3.00

When this writer first studied thermodynamics in college thirty years ago, it was renowned as a "heavy" subject, possibly because of that 30-yr old textbook, weighing 3½ lb, full of thick papers imprinted with thick words.

No wonder thermo had us floored until a few men came along like the late J. E. Emswiler, whose text on thermo has for many years won deserved recognition, not only from the baffled undergraduates, but also from practicing power engineers and rightly so. Professor Emswiler not only had the faculty of presenting the science in understandable language, but also of relating the thermodynamic concepts to the actual heat utilizing machinery with which the average engineering student and the average practicing engineer first comes in contact. As a result, the reader of Emswiler could get some sort of physical conception of the matters discussed and could see why there had to be a difference between ideal and actual performance. Furthermore, there is practically no calculus used in Emswiler's book, only ordinary algebra. While this is not a particular disadvantage for a junior engineering student who is usually taking calculus at the same time, it is a great advantage to the practicing engineer who through disuse has completely forgotten what calculus he did have. In short, Emswiler has always seemed to us a very good book for the practical engineer.

The fifth edition of Emswiler, revised by Professor Schwartz, contains only 25 fewer pages than the fourth edition, yet it is only half as thick, measures an inch less in both height and width. As a result, it seems much less like a tome, less likely to scare the reader by its very size and imposing appearance.

Professor Schwartz' revision incorporates some additions and revisions necessitated by recent developments in the presentation of the subject. The lucid explanations, illustrated examples, free use of diagrams and graphic representation used by Professor Emswiler in earlier editions have been retained. The general case has been presented before the specific. The several phases of the working substances are presented in general and vapors and gases are considered after that. The polytropic processes for gases is presented in detail, followed by the adiabatic, isothermal, constant-pressure and constant-volume processes as special applications of the polytropic.

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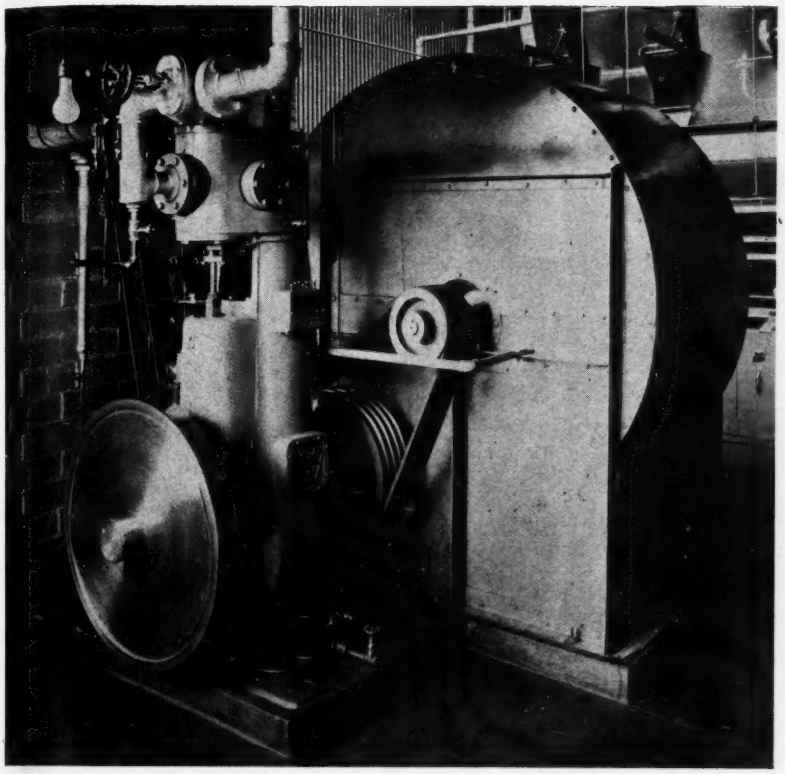

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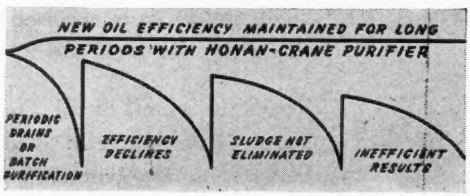
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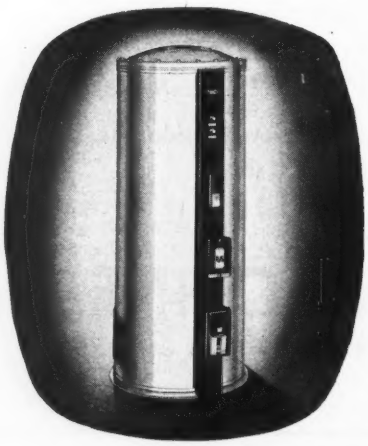

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 Boiler Tube Cleaner — Bulletin shows how use of Airetool tube cleaners quickly remove fuel wasting scale. New form cutter used in cleaner head will not damage hard-to-replace tubes. Sizes for straight or bent tubes, ½ to 20 in. Airetool Mfg. Co.

2 Stoker Maintenance Data — "Fundamentals of Stoker Operation and Maintenance"—a booklet that sets forth fundamental facts concerning operation, lubrication, inspection and maintenance of stokers of all types is now available. Examples are given of oil fired boilers converted to coal firing. Included in the booklet is a technical paper, "Some Ways to Avoid High Stoker Maintenance." Combustion Engineering Co., Inc.

3 Oil Burners—Catalog giving technical details on the design and application of burners for oil, gas, pulverized fuel and combination fuels, with particular emphasis on economy and operating range. Peabody Engineering Corp.

4 Compact, Quick Steaming Boiler—A new compact steam boiler, The O & S Powermaster, is described in Bulletin No. 1213. This modern packaged power plant will be of especial value in food processing plants, as well as in laundries, dairies, and in all industries where quick steam is needed for processing, power, or heating. The boiler develops 100 lb pressure from 60-deg water in 18 minutes or less. Fully automatic; 10 to 100 hp oil firing units; meet all ASME requirements. Orr & Sembower, Inc.

5 Boiler Metal Protection — Bulletin 1290 describes Apexior, the long lasting scale-resistant coating for boiler metal. Applied with hand brush or power coater after cleaning down to bare metal. One application is said to last 2 to 3 years. The Dampney Co. of America.

6 Super Duty Refractory Brick—Bulletin describes three new McLeod & Henry fire clay brick products: Hyex, Super-Hyex and Superam. These super duty refractories are designed to supply the demand for fire clay bricks possessing greater spalling resistance, greater load bearing strength and greater stability. All are made from specially selected Missouri flint clays, moulded with considerably higher than usual pressures. Complete information regarding available sizes and exact application is included in this bulletin. McLeod & Henry Co., Inc.

7 Pneumatic Ash Handling System—New 30-pg catalog describes Beaumont Birch "Vac-Veyor" system for the automatic removal by suction of ashes, fly ash and soot. Gives diagrams, dimensions and specifications covering two sizes and two types of the system—for delivering ashes either dry or damp. Beaumont Birch Co.

ELECTRICAL

8 Hints On Arc Welding—Loose leaf data bulletin "Practical Design for Arc Welding" contains time-saving tips for making or repairing valve bodies, engine bases, bearing blocks, fan rotors and other machinery. Sixty drawings suggest how to coordinate good design with available materials and equipment. Should be of value to design engineers, operating and maintenance men. Hobart Brothers.

9 Dry-Type Distribution Transformer—Described in publication GEA-3714B are G-E dry-type transformers for use on circuits of 601 to 15,000 volts. They are cooled by natural circulation of air; are insulated by air and solid dielectrics, without the use of any cooling or insulating liquid. Built-in terminal compartments permit completely metal-enclosed installation. General Electric Co.

10 Busways and Wireways—A complete 36-pg bulletin on Saflex Plug-in Duct, Saflex Feeder Duct, Square-Duct and Screw Cover Duct for electrical distribution systems has been issued. Includes description and application data, performance charts, example layouts, price information and other helpful information. Square D Co.

11 Arc Welding Procedures for Cast Iron—Making repairs on iron castings by electric arc welding is explained in a 12-pg illustrated booklet, "4 Ways to Salvage, Reclaim and Conserve Iron Castings by Electric Arc Welding". Opens with a frank discussion on the difficulties encountered in arc welding cast iron, points out that there is no single welding material or procedure which can be recommended as a universal practice. Four types of electrodes for use on cast iron are described, and the characteristics and best welding procedures for each are explained. C. E. Phillips & Co.

12 Instrument Transformers—Practical data given in Westinghouse Instrument Transformer Catalog No. 45-000 should make it easy to select proper units for every job. These transformers benefit by the use of Hipersil steel, which carries 1/3 more flux with less weight. Westinghouse Electric & Mfg. Co.

13 Low-Voltage Air Circuit Breakers—Catalog 1002, includes sections on selection and construction of I-T-E low-voltage air circuit breakers. The Selection section contains rules for approximating the necessary interrupting capacity of circuit breakers on both a-c and d-c systems Two cases are considered for a-c systems, where the primary is of limited capacity, and where it is "unlimited". "Cascading", or the use of "back-up" breakers, now mandatory when it will save material, is also explained. In the Construction section are schematic diagrams illustrating the trip-free operation of a circuit breaker when closing against a fault, as well as the normal open and closed positions. I-T-E Circuit Breaker Co.

14 All-Weather AC Welder — Literature describes Wilson "Bumblebee" AC welders which are now available in All-Weather models of 300 and 500 ampere capacities. These machines have special moisture-proof insulation throughout and are equipped with a low voltage contactor which automatically holds the open circuit voltage at approximately 40 volts. Wilson Welder and Metals Co., Inc.

15 Automatic Welding Cranes—Illustrated bulletin, Unit 68, has been published by Whiting Corporation, describing their special automatic welding cranes—a design developed by Whiting engineers to facilitate the handling of large welding jobs. Flux recovery systems, control panel adjustable boom, welding head adjustment and other features are illustrated.

FANS, PUMPS AND COMPRESSORS

16 Pump Service Manual—New 20-pg service manual explains the basic principle of Viking rotary pumps, and supplies valuable information on their installation and care. Chock-full of data useful to pump operators. Viking Pump Co.

17 Plain Talks On Compressors—A well illustrated 24-pg booklet "Plain Talks on Air and Gas Compressors" highlights for compressor users the basic principles which underlie the successful operation and maintenance of their equipment Worthington Pump & Machinery Corp.

18 Portable Air Compressor—Bulletin 4320 describes "a lot of air compressor in a very small package"—the Schramm model No. 20. Has two power and two air cylinders; delivers 20 cfm at 100 lb pressure; comes with skid or two wheel mounting. Uses include Diesel engine starting, oil tank pressuring, operating scaling tools, etc. Schramm, Inc.

19 Pump Bulletins—Complete details on Warren pumps are contained in Bulletins 228 and 229. Dimensional data, capacities, etc., on a complete line of centrifugal, liquor, duplex and single piston, plunger, vacuum, etc., will enable you to find just the pump to fit your particular needs. Warren Steam Pump Co.

20 Keeping Water Out of Compressed Air—Literature tells how controlled temperature cooling with the Niagara Aero After-cooler keeps water and oil out of compressed air lines. Condenses the moisture before it gets into lines: also provides jacket water of proper temperature to prevent condensation in compressor. Niagara Blower Co.

INSTRUMENTS AND CONTROLS

21 Automatic Controls—New Catalog No. 600 covers complete line of Mercoid automatic controls for heating, air conditioning, refrigeration and industrial applications. Controls have dust-proof. non-sticking mercury contact switches. Catalog includes control wiring diagrams, specifications, conversion tables, other useful engineering data. The Mercoid Corp.

List Items You Want On Handy Coupon On Following Page

22 **Boiler Water Columns** — Catalog 415 describes boiler water columns with and without alarms, for pressures above 250 lb. Completely illustrated; also includes water gage equipment, ASME code requirements and other useful data. The Reliance Gauge Column Co.

23 **High Accuracy Flow Rate Meter**—New Bulletin 300 covers the operation, applications, specifications and high accuracy of the Simplex MO flow rate meter. Contains capacity table, diagrams showing application to various primary devices, flow scale charts and other data useful to operating engineers and management men. Simplex Valve & Meter Co.

24 **High Speed Motorized Valves** — Bulletin A3 gives detailed engineering and application data covering ATC's line of high-speed motorized valves for "On-Off" control of steam, air, oil, gas or chemical solutions. Construction and operating features fully illustrated and explained by simple tables. Includes valve information and selection chart to assist in proper valve selection based on speed, stroke and operating power required. Automatic Temperature Control Co., Inc.

25 **Applications of Electronic Control** —The fundamentals and the various applications of electronic control are interestingly described in a new 12-pg bulletin (GEA-4126). The publication explains in clear, simplified language the basic principles of electronic tubes and their operation, describes the construction of the well known thyratron tube, and lists the functions of eight of the more widely used industrial-type tubes. Also illustrates many practical applications of electronic control, including rectification, resistance welding, timing, and processing operations, as well as photoelectric installations involving counting, sorting, weighing, measuring, registering, illumination, and the control of cement kiln temperatures. General Electric Co.

26 **Dead Weight Gage Tester** — Described in a recent folder is the R.S. portable dead weight gage tester for work up to 4000 lb. Made of brass and fastened to hardwood base. Plunger for developing oil pressure has a crank-handle for convenient operation. Guaranteed accuracy is 1/10 of 1%. The Refinery Supply Co.

27 **Adjustable Water Gages**—Recent bulletin describes Ernst Split-Gland adjustable water gages. Unobstructed view of water level, glasses set at any angle, no hot nuts to handle and cool—are among advantages claimed for this gage. Folder also pictures other boiler specialties. Ernst Water Column & Gage Co.

28 **New Electronics Bulletin**—Bulletin No. 9143 covers operation of photoelectric devices for automatically controlling equipment for production, safety, lighting, combustion, sabotage, burglary, etc. Especially edited in non-technical language for general understanding. Contains illustrations of many applications, also describes Worner Combustion Supervisor for smoke detection. Worner Electronic Devices.

29 **Sight Flow Meters**—Attractive new Bulletin 10-B covers design and application of Fischer & Porter Rotameter sight flow meters. They are said to measure any acid or alkali; measure such "tear drop" liquid rates as ½ cc per min; handle any highly viscous fluid; operate at any high or low pressure. Many flow rate charts, equipment hookup drawings and other data make this a valuable book for production men and operating engineers. Fischer & Porter Co.

30 **Handy CO_2 Analyzer**—Bulletin 338 describes simplified Firite "Orsat" analyzer. Held in hand while you make tests. A complete analysis in 40 seconds. Also tells about Fire Efficiency Finder—a calculator that converts CO_2 and stack temperature readings into heating efficiency percentages. Bacharach Industrial Instrument Co.

31 **Mechanical Feed Water Control** — The Sixth Edition of the textbook, "Mechanical Feed Water Regulation for Boilers" by Professor E. P. Culver is now available. This 36-pg booklet covers the principles of boiler feed water control, and describes mechanical equipment available to meet various operating conditions. Differential pressure control and feed pump control are also discussed. Contains numerous illustrations, diagrams, and chart reproductions. Northern Equipment Co.

MECHANICAL TRANSMISSION

32 **New Magic Grip Sheave**—Bulletin B6310 contains six photographs illustrating the easy put on-take off operation of the new Texrope Magic Grip Sheave. It is said to fit oversize or undersize shafts, center perfectly, run smoothly, save man-hours by faster mounting. Allis-Chalmers Mfg. Co.

33 **Calculating Chain Drive Centers**—In order to shorten the time required for calculating center distances and chain lengths of chain drives operating over cut-tooth wheels, Link-Belt Company has computed and published a series of tables which give very accurate results. The number of teeth in small sprocket wheel of the drive is given in the upper right-hand corner on the right-hand page of each spread of pages of this book No. 1991. The number of teeth in the large wheel appears at the top of each of the tables. The body of table gives exact center distances for a chain of one-inch pitch and of the length listed in pitches in the first column. Center distance for any other pitch of chain may be obtained by multiplying the centers in table by the pitch.

34 **Handbook On Chain Drives** — Designed to supply design engineers, plant production men, and purchasing agents with recent and complete information on Morse silent chain drives, a new Bulletin 43 is now ready for distribution. In addition to usual specifications and price lists, this 80-pg bulletin includes a section on simplified methods of drive selection based on latest Morse practice in high-speed drive design, and engineering data on chain and sprocket construction together with a comprehensive list of stock drives based on a new, quick method of selection. Another addition to the usual material is a more complete section on installation and maintenance. Morse Chain Co.

PIPING, VALVES AND FITTINGS

35 **Pipe Coating Handbook**—New 82-pg handbook tells how to prevent and cure damaging condensation on metal pipes and fixtures, basement walls, ceilings, concrete, etc. Contains instructions on application, coverage, drying time and many uses for Nodrip coating and other pertinent data. J. W. Mortell Co.

36 **Traps For Compressed Air** — New Bulletin 341 illustrates the Nicholson Model "JR" weight operated trap for automatically draining water and oil from compressed air intercoolers, aftercoolers, separators, receivers, etc. An easy-to-understand diagram in the bulletin features the places where the traps are used to drain the various pieces of equipment. W. H. Nicholson & Co.

37 **New Valve Selection Chart**—Valve selection made easy, is the theme of the new valve selection chart, 11½ in. x 17 in., printed on heavy cardboard by the Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc. By a simplified breakdown of CONDITIONS to consider when selecting, and an explanation of what these conditions DETERMINE in the operation of a valve, this chart offers the valve buyer a "slide-rule" for valve selection. An additional feature is the more comprehensive explanation below the breakdown and also the "example" which uses the facts brought out in the chart for selecting the right valve for a specific condition.

38 **Valve Reseating Machines** — Catalog 40—32 pg—offers complete explanation of construction and operation of valve reseating machines for either gate, globe or pump valves. Easily operated, reliable, efficient and durable, these machines save valves from discard many times. The Leavitt Machine Co.

39 **Pipe Expansion Calculator**—Simple, time-saving slide rule shows expansion in 100 ft of pipe—for various materials and temperature ranges. Abbreviated steam table printed on face of calculator. Easy to work; no chance of errors. American District Steam Co.

40 **Pipe Tools**—Toledo pipe threading devices, bolt threaders, pipe cutters, reamers, pipe vises, power pipe machines and other modern pipe tools are pictured and described in latest Catalog 43. Gives shipping weights, prices and other data. The Toledo Pipe Threading Machine Co.

WATER TREATMENT

41 **Portable pH Testing Set**—Folder tells all about portable micro unit for testing pH. Requires less than 0.5 ml. sample; accuracy within 0.1 pH; turbidity and color in sample does not interfere with determination. LaMotte Chemical Products Co.

42 **Hot Process Water Softeners** —Cochrane's Reprint No. 30, "Improvements in the Hot Process Water Softener", covers a brief history of the development of this most versatile and popular method of feed water conditioning. Following the historical presentation the chemical reagents are discussed

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and new improvements both chemical and mechanical. Illustrations show the possibilities of silica removal, reduction of organic matter and typical installations showing many adaptations of this equipment. Cochrane Corp.

43 Water Treatment Data Book—Completely revised data book on water treatment contains 78 sections of data in addition to 36 tables and 10 graphs. It has hundreds of chemical conversions and equations. Gives methods of calculation of water conditioning problems and should be in the library of every engineer or chemist who comes in contact with water treatment. Permutit Co.

44 Industrial Cleaning Service—Bulletin tells about the development of Dowell chemical method for removing water- or steam-deposited sludge and scale from all types of industrial equipment. Lists actual results of this cleaning service in boilers, condensers, water lines, economizers, distillery, blast furnace. Contains typical hookup diagram. Dowell, Inc.

45 Automatic Proportioning Equipment—Bulletin No. 1700 describes the complete line of %Proportioneers% constant rate and flow responsive proportioning equipment. Contains flow diagrams showing latest applications for the process industries. Among operations diagrammed are: Treating water, food products, oils and boiler water; Blending ingredients in the production of plastics, synthetic rubber, lubricating oils and aviation gasolines; Diluting caustic or other concentrate. %Proportioneers, Inc.%

MISCELLANEOUS

46 Easy-To-Cut Insulation — Mono-Block, a felted block insulation effective for temperatures up to 1700 deg F, is described in new folder. Low thermal conductivity, light weight, easy cutting and fitting, are features of this new insulation made from black rockwool. Baldwin-Hill Co.

47 Elevator Lubrication and Maintenance—New 6-pg treatise describes different classes of elevators; offers practical suggestions on lubricating gears, guide rails, plungers, cables, motors, sheave wheels and other parts. Maintenance tips are also given on auxiliary equipment such as air compressors, ventilating fans, steam engines and pumps. Should prove helpful to operating and maintenance men. Keystone Lubricating Co.

48 Recharging Fire Extinguishers — A new booklet on "Recharging Instructions for Carbon Dioxide Extinguishers," has been published by the C-O-Two Fire Equipment Co. Made up in pocket size, the booklet is illustrated with detail drawings of the equipment required for recharging and the procedure to be followed in recharging both system cylinders and portable extinguishers made by the C-O-Two Company. Copies will be sent on request to those with facilities for recharging this equipment.

49 Resurfacing Rutted Floors—Maintenance men will find helpful hints on making quick repairs to factory floors in recent Stonfast folder. It describes how Stonhard Concretite produces a flinthard surface, ready for traffic in 18 to 24 hr. Stonhard Co.

Following literature may be obtained only by writing directly to the manufacturer named.

Gunite Application Book—Bulletin 2200 contains photographs showing how Gunite is used for repairing stacks and bunkers, furnace refractories, reservoirs, dams; for steel encasement, etc. Contains useful tables and charts on compression value, safe live loads of Gunite. Cement Gun Co., Allentown, Penn.

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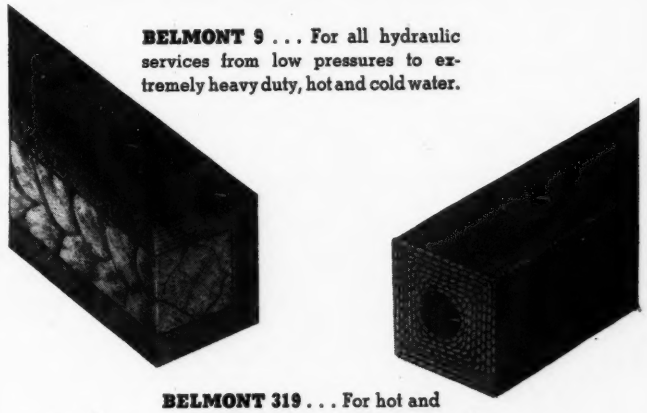

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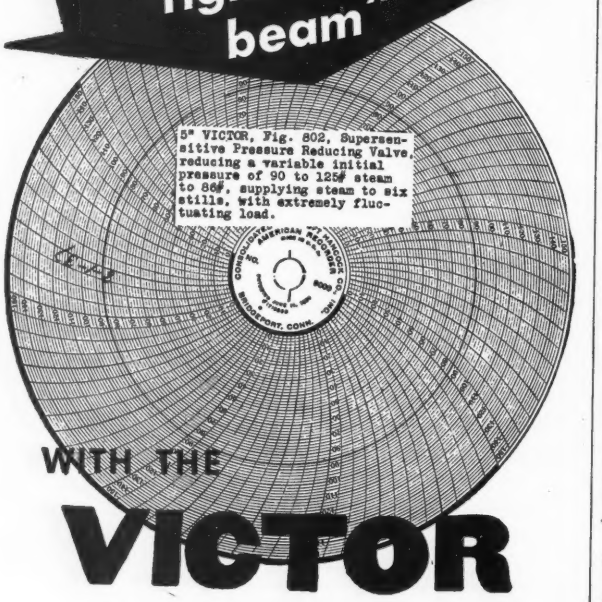
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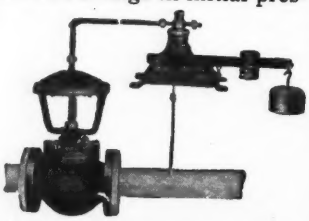

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☐ Thermostats
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☐ Control Valves

More emphasis on gases and the general energy equation for steady flow processes appears in the new edition than in former editions.

Throughout this edition, ASA symbols and abbreviations have been used.

New materials on absorption refrigeration, gas turbines, gas cycles, adiabatic saturation of air, water, vapor mixtures, and supersaturation has been added.

Not being a thermodynamic expert, this writer is not competent to say whether the changes in arrangement of material referred to above improves the book for the average engineer or not. Most of the same material is there, however, as in previous editions. For those who have used Emswiler before, it might be wise to stick to the older editions in which you know the arrangement. But perhaps the process of teaching thermo to the neophyte will be helped by the new technique incorporated in this edition. It may be expected to have the same wide acceptance and general approval as were accorded previous editions.

Power Unleashed. By M. M. Samuels. Size 5½ by 8½ in.; 300 pp; cloth bound. Published by Dorset House, Inc., 55 West 42nd St., New York, N. Y. Price $3.50.

For a long time it has seemed to us that a book such as this was needed badly, not only by the general public, but also by the power engineering industry itself. Power is such a fundamental factor in our present civilization that everybody, including the power engineer himself, takes it entirely too much for granted, just as we take paper for granted, another fundamental industry. To emphasize this fundamental importance of power, we need two things: first, a description of what the power industry actually is, as an aggregation of equipment and the men who design, construct and operate it; second, an interpretation of what it means, not only to the men who work in the industry but also to society as a whole.

It is this type of interpretation that Mr. Samuels has attempted very successfully to give in this book. He has had wide experience in the generation and distribution of electric power; an engineer reading his book will readily recognize that the author is speaking from personal experience. It is true that for his present purpose he is forced to over-simplify certain of the technical details of the business, but it must be remembered that he is primarily trying to show what the power industry means rather than to discuss operating details that engineers know.

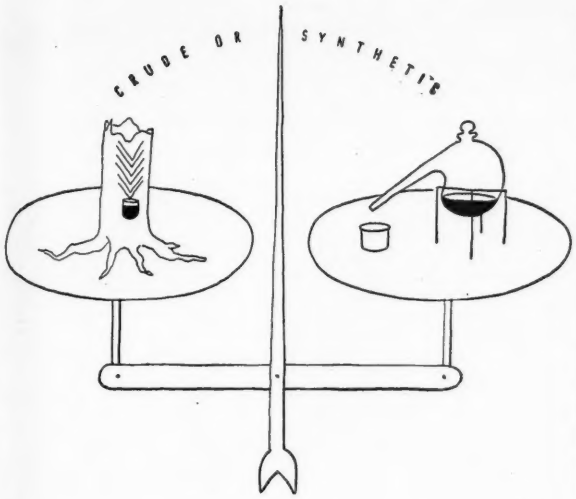
The author begins with a good discussion of what electrical energy is, where it comes from and how it is distributed and utilized in various forms. Then in a chapter entitled Energy Bound and Energy Boundless, he gives a general picture of the way in which we have to control energy in order to utilize it effectively. The following chapters are entitled, respectively: We Visit a Water Power Station; Fire or Water; We Visit a Steam Plant; and The Engineers of Power, telling something about the men who do the job and what they have to do. The final chapter of the book discusses Power of the Future.

This book needed to be written; Mr. Samuels has done a splendid job; the book should be read by power engineers and recommended highly to their non-engineering friends and co-workers who frequently have to make decisions that affect the future of the entire power industry. It deserves the widest circulation.

Iron and Steel Pop Safety Valves. Published as Simplified Practice Recommendation R201-43 by the United States Department of Commerce, National Bureau of Standards. Size 5½ by 8½ in.; 11 pp; paper bound. Obtainable from the Government Printing Office, Washington, D. C., for 5 ct.

The simplified practice recommendation given in this pamphlet was developed at the request of the Shipbuilding Division of the WPB by the segment committee of the Valve Industry Advisory Committee, collaborating with the National Bureau of Standards. The purpose of simplifying the line of iron and steel safety valves is primarily to enable the valve industry to expand production in order to meet the requirements of the war agencies and of regular industrial users. The recommendation has been accepted by a large majority of the manufacturers and a representative list of distributors and users. For all these reasons, the pamphlet should be very useful to power engineers and any other engineers who must specify and install such valves under the present emergency conditions.

Steel Products Manual. Size 6 by 9 in.; 215 pp; paper bound. Published by the American Iron and Steel In-



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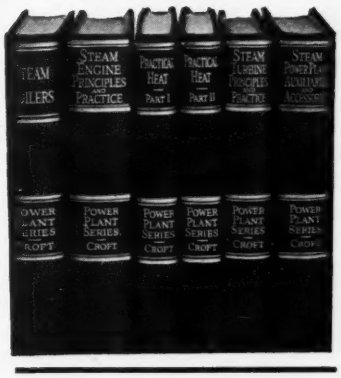

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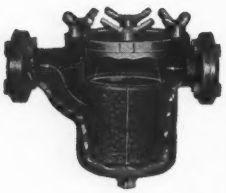

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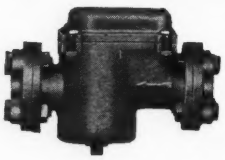

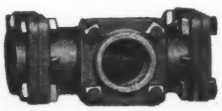

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stitute, 350 Fifth Ave., New York, N. Y. Price $2.50.

For anyone who must have information about packaging, marking and loading methods for steel products for overseas shipment, this book will prove invaluable. It gives instructions prepared by a committee of the American Iron and Steel Institute, representatives of the U. S. Government bodies concerned with the problems, Army Services Forces, the Navy Department, foreign purchasing missions, freight handlers and other interested parties.

The book is divided into five sections of instructions, followed by a large number of sections on details of handling specific materials. The first five sections cover general instructions, packaging detail code, protective coatings, packaging materials and definitions of terms. The detailed sections, which are well illustrated with sketches and drawings of approved methods, relate to packing of billets, slabs, rods, plates and various types of sheets and strips, as well as wire, railroad rails, tie plates, tubing and many other steel products.

Principles and Practice of Flow Meter Engineering. By L. K. Spink. 5½ by 8 in.; 220 pp; flexible cloth binding. Published by The Foxboro Co., Foxboro, Mass. Price $3.00.

Although this book is referred to by the publisher as a handbook, it should be a very valuable textbook for students of the subject, for it contains a great deal of the information needed in practical flow meter engineering that never seems to get into the usual textbook and that is learned only from actual experience by men working constantly with flow measurement problems. This is the sixth edition since the book was first published in 1930. New and advanced phases of the subject are covered in it for the first time, bringing the book up to date.

The author is a member of the working committee which developed the latest AGA orifice meter tables, a member of the ASME Fluid Meter Research Committee, and of the joint AGA and ASME Pulsation Research Committee.

The book is divided into two parts, Part I on Liquid Flow Measurement, Part II on Gas Flow Measurement.

In the liquid section, methods for determining compressibility factors of liquids at temperatures near the critical, a new and more accurate method of correlating temperature expansion data on petroleum oils, a quick method of correcting for tap locations, and a short-cut method of correcting for viscosity are some of the features.

In the gas section, several methods of correcting for viscosity effects are discussed, and theory, working equations and tables for moisture and super-compressibility are presented. A new and simple type of intermediate pressure device which eliminates the by-passing of gas is described. Data are given on the latest findings on the measurements of pulsating gas flows. The book is filled with tables, charts, diagrams and practical methods for calculation of specific flow measurement problems.

The Noise Primer. Published by the General Radio Co., Cambridge 39, Mass. 6 by 9 in.; 43 pp; paper bound. Distributed free of charge.

This is the most complete yet concise compilation we have seen of the elemental principles and procedures involved in the measurement and analysis of sound and vibration. The book, says the author, is neither an instruction book nor a textbook. Nevertheless, it will give engineers a great deal of information on the subject that they never knew existed before unless they have made themselves specialists in sound.

The booklet, says the author, is both an apology for the "everybody - ought - to - know - that" attitude and a real attempt to help those who, in the past, have had no more reason to know about sound measurements than the communications engineer has had to know about blowers or turbines. However, as speeds of equipment increase under modern conditions, the problems of vibration become increasingly important to all engineers and this booklet will provide them with a very good foundation.

It discusses in detail the sound-level meter, the decibel, how to use a sound-level meter, practical applications of the meter, analysis of noise, how to use the sound analyzer and the vibration meter, and analysis of vibration. Details of equipment are shown and there are many curves and diagrams taken from the actual equipment.

Plastics. By J. H. DuBois. Size 5½ by 8½ in.; 435 pp; cloth bound. Published by the American Technical Society, 58th St. and Drexel Ave., Chicago, Ill. Price $3.75.

For the engineer who needs some information on the characteristics of the various plastics and details of the methods of fabricating them into various finished products, without spending all the time required for a detailed study

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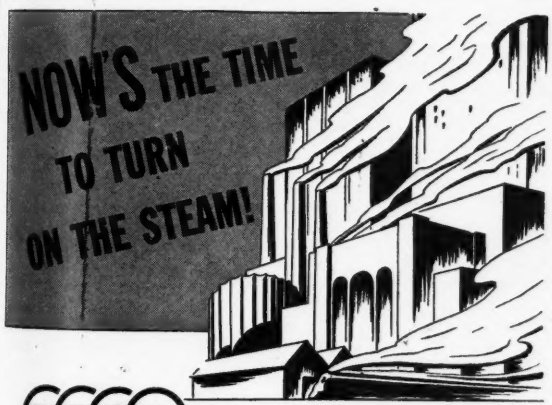

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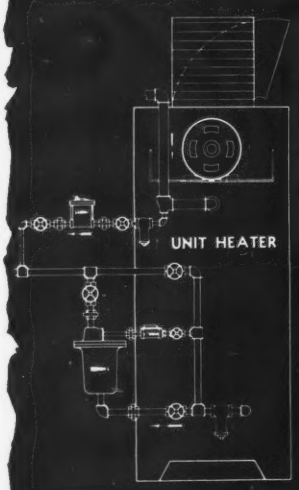

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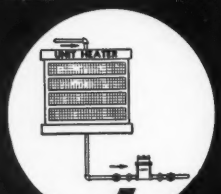

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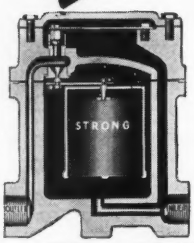

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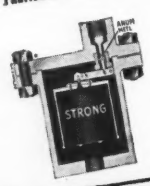

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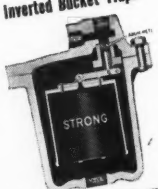

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STRONG
STEAM SPECIALTIES

of plastic chemistry or the complex manufacturing problems of the fabricator, this book is heartily recommended.

The first edition of the book, noted in POWER PLANT ENGINEERING, August, 1942, was reprinted twice and had wide distribution. The revised edition includes most of the material in the first edition, with minor changes to bring it up to date, and, in addition, 144 entirely new pages. This new material covers the various types of synthetic rubber, low pressure laminating, trends and developments, and general properties and uses for molded plastics materials.

The book explains in interesting form how various materials are put together to form plastics. It omits formal chemistry but explains what happens when various materials are handled in certain manners, and shows how all plastic materials are used, what can be made with them, where to use various kinds, how to form them, required tooling, machining and the like. The book is definitely for the user of plastics and not for the chemist or research laboratory.

Chapter headings are as follows: An Introduction to Plastics; The Phenolic Plastics; The Urea or Amino Plastics; The Cellulose Plastics; The Acrylic, Vinyl and Styrene Plastics; The Cast Phenolic and Protein Plastics; Other Plastics Materials; Cold Molded Plastics and Shellac; The Laminated Plastics; Compression and Transfer Molding; Injection Molding and Continuous Extrusion; Finishing and Decorating Plastics Products; Selecting Materials for Molded Products; Design of Molded Products; Synthetic Rubber; Low Pressure Laminating; Trends and Developments; General Properties and Uses for Molded Plastics Materials.

Fracture and Ductility of Lead and Lead Alloys for Cable Sheathing. By Herbert F. Moore and Curtis W. Dollins. Size 6 by 9 in.; 64 pp; paper bound. Published as Engineering Experiment Station Bulletin Series No. 347 by the University of Illinois, Urbana, Ill.

At the beginning of the study of cable sheathing about 14 years ago, attention was focused on a new problem that had arisen in connection with the operation of high-voltage impregnated-paper-insulated cables. The use of higher operating voltages had necessitated an increased oil content of the impregnated-paper insulation. Internal pressures developed by this oil caused expansion of the lead sheaths which, when the cable cooled during decreasing load, permitted gas pockets to form in the solid-type cable or oil pockets to form in oil-filled cable. These pockets were weak electrically and were, therefore, undesirable in high-voltage cable insulation. The research was directed mainly toward the subject of the long-time creep of lead and the commercially available lead alloys.

As test results were obtained on this subject of creep, many of the sheaths in service were expanding to the breaking point. Localized cracks developed which obviously would permit oil to leak out and air and moisture to enter, with consequent impairment of the insulation of the cable.

Until May 15, 1944, or until the supply available for free distribution is exhausted, copies may be obtained without charge. After that it will be 75 ct.

Fatigue Tests of Commercial Butt Welds in Structural Steel Plates. By Wilbur M. Wilson, Walter H. Bruckner, Thomas H. McCrackin, Jr., and Howard C. Bede. Size 6 by 9 in.; 140 pp; paper bound. Published as Bulletin Series No. 344 by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Price 75 ct.

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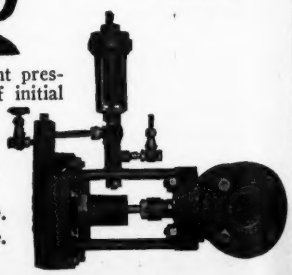

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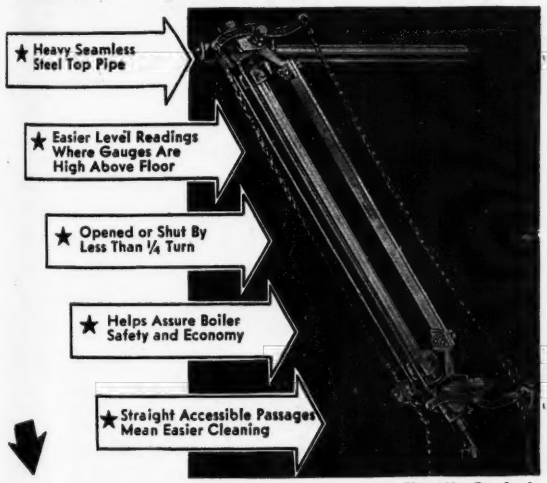
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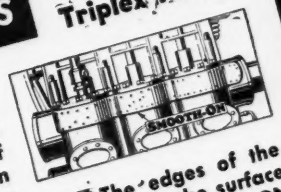

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This bulletin describes various series of tests made on butt welds in 7/8-in. carbon-steel plates. One series of specimens, referred to as the "basic series," was welded in the flat position by a skilled welder using a manually-operated metallic arc, and working under expert supervision. These welds were considered as representative of the best that could be expected under the present stage of development of the art. Several other series of specimens in which the welds were produced under commercial conditions, some welded in the shop and some in the field, were tested so that the results obtained might be compared with those of the basic series. The dimensions of the specimens were the same for all series. The fatigue strength of a member, as the term is used here, is the maximum stress in a stress cycle that will cause failure at a definite number of cycles when the ratio of the minimum to the maximum stress in the cycle has a definite stated value. Values of the fatigue strength corresponding to failure at 100,000 cycles and at 2 000,000 cycles were determined. Until May 15, 1944, or until the supply available for free distribution is exhausted, copies may be obtained without charge. After that it will be 75 ct. per copy.

Diesel Locomotives, Mechanical Equipment, and Diesel Locomotives, Electrical Equipment. By John Draney. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price $4.00 each.

Here are companion how-to-do-it books on the operation and maintenance of both the mechanical and electrical equipment of Diesel railway locomotives. The author is past-president of the United Associations of Railroad Veterans and has had wide experience in this field. The books are extremely practical and up-to-date, dealing with equipment now in use and giving the most specific instructions about the handling of details. Illustrations are all photographs or drawings of the latest types of equipment. Aside from the application of this equipment to railroad work, a great many of its principles are fundamental in the operation of stationary Diesels and anyone interested in Diesel engine work in general should get much information from these books.

The book on mechanical equipment discusses engine cycles, combustion principles, fuel-injection, lubrication and cooling systems, governors supercharging and turbocharging, air filtration. These topics are followed by detailed descriptions and operating instructions for a number of the commercial engines now in use. The final chapters deal with description and operation of mechanical equipment, maintenance instructions, trucks, auxiliary equipment, and the Vapor-Clarkson steam generating units. The book is well indexed.

The book on electrical equipment contains introductory chapters on electrical fundamentals and maintenance, generators, motors, control apparatus and wiring, and the other equipment required to transmit power to the locomotive wheels. This is followed by extremely detailed chapters on specific makes of electrical equipment and auxiliaries. Like the mechanical equipment book, it is extremely practical and deals with the latest types of railway equipment.

Salvage Manual for Industry. Edited by 7 engineers. Published by Technical Service Section, Industrial Salvage Branch, Salvage Division, WPB. Paper-bound, 6 in. x 9 in., 250 pp. Price 50 ct. Procurable through the Superintendent of Documents, Government Printing Office, Washington, D. C.

The first comprehensive practical manual on industrial salvage ever prepared has just been published by the Technical Service Section, Industrial Salvage Branch, Salvage Division, War Production Board, and is now being distributed to industry.

The new book contains systematically organized and classified data—most of it of a "how-to-do-it" nature—on industrial salvage practice in all its ramifications. There are 2 chapters on organizing and planning the salvage department; 3 on the administrative factors; 12 on methods of handling (finding, identifying, segregating, collecting, reclaiming, storing, selling, etc.) metal scrap; 3 on non-metallic waste; 7 case histories demonstrating exemplary practice; a 17-page compilation of practical hints for handling specific waste materials; and a 9-page index.

The well-illustrated volume was prepared and edited by an editorial board of practical industrial salvage engineers and business paper editors. Assisting the editors either with direct contributions or advice was a corps of some 40 engineering or salvage experts. No effort has been spared to cover every possible phase of practical industrial salvage operations and to present the most reliable and authoritative information about them.

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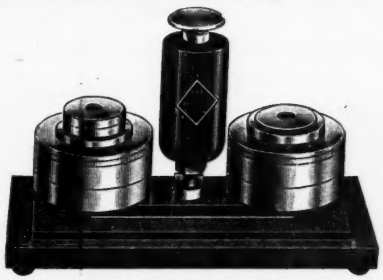

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Power Plant Construction News

Calif., Los Angeles—B. F. Goodrich Co., Inc., 5400 East Olympic Blvd., manufacturer of tires and other rubber goods, plans installation of electric power equipment in new additions to local plant, comprising several one-story units, reported to cost in excess of $100,000. Project has a priority rating and will be placed under way at once. Albert C. Martin, Higgins Bldg., Los Angeles, is architect. Main offices of company are at Akron, Ohio.

Colo., Golden—Board of Trustees Colorado School of Mines, plans new boiler plant at institution for central-heating service, as a postwar project. Work will be carried out in conjunction with proposed new chemistry building, entire development estimated to cost over $500,000.

D. C., Washington—Potomac Electric Power Co., Tenth and E Sts., N.W., has secured resumption of priority rating by WPB, following cancellation a number of months ago, for expansion in Buzzard Point steam-electric generating station, to include installation of new 50,000-kw turbine generator unit and auxiliary equipment, and program will be resumed at early date. It is scheduled for completion in summer of 1945. Project will include line extensions. No official estimate of cost announced.

Idaho, Pocatello—Bureau of Yards and Docks, Navy Dept., Washington, D. C., has authorized expansion in power plant at Naval Ordnance Plant, Pocatello, with installation of new 500-kw Diesel engine-generating set, and auxiliary equipment, reported to cost close to $131,000. Also for extensions in power station at Naval Proving Ground, Arco, Idaho, with installation of two Diesel engine-generating units and accessories. Proposed to carry out work soon.

Iowa, Grundy Center—Grundy County Rural Electric Cooperative, Grundy Center, plans extensions in rural electric system in Grundy County, including new lines, service connections and other operating facilities. Cost about $70,000, with financing provided by Federal aid. It is understood that project will have a priority rating.

La., Lafayette—Water and Light Dept., is considering a postwar project at municipal power plant, including installation of new generating unit and auxiliary equipment. Also for extensions in distribution lines and street-lighting system. Entire project is reported to cost close to $350,000.

La., New Orleans—Higgins Aircraft, Inc., Micheaud district, manufacturer of light-type airplanes, plans installation of electric power equipment in new additions to plant, comprising hammer and forge shop, foundry, machine shops and other structures. Entire project will cost about $3,750,000, with financing provided in that amount by Defense Plant Corp., Washington, D. C., Federal agency. Work will begin at early date. Company is affiliated with Higgins Industries, Inc., 521 City Park Ave., New Orleans.

Mass., Chelsea — State Military Dept., State House, Boston, Mass., plans new boiler plant at Soldiers' Home, Chelsea, as a postwar project. Cost estimated close to $100,000, with boiler units, pumps and auxiliary equipment. Hollis French, 210 South St., Boston, is consulting engineer.

Minn., Madison—Municipal Light & Power Dept., has preliminary plans for a postwar development at municipal power plant, with installation of new steam turbine-generator unit, high-pressure boiler and auxiliary equipment, to replace present reciprocating engine and generating unit, and provide increased capacity. Estimates of cost are being made.

Minn., St. Paul—Minnesota Farm Bureau Service Co., 101 Fairfield Ave., plans installation of electric power equipment in new commercial fertilizer-manufacturing plant on Mississippi River, between Chester and Alabama Sts. It will comprise a main building and several auxiliary structures, estimated to cost close to $240,000. Structure will be erected by Minnesota Farm Bureau Federation, Globe Bldg., St. Paul, and occupied under lease. Toltz, King & Day, Inc., Pioneer Bldg., St. Paul, is architect and engineer.

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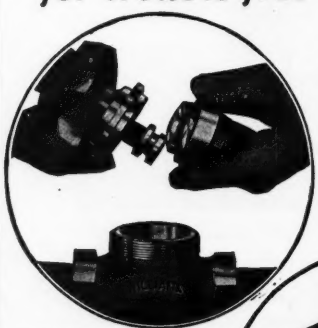

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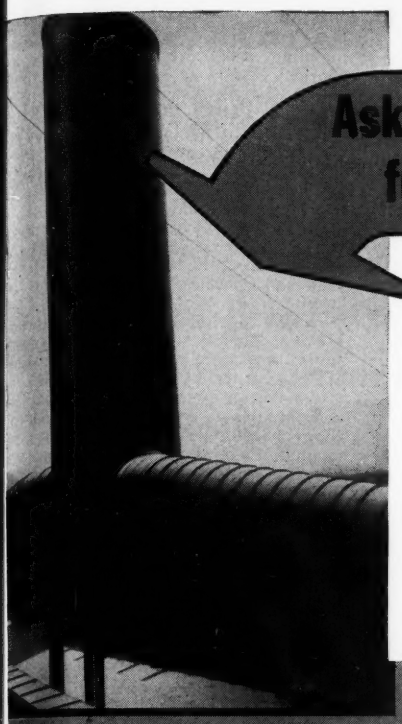

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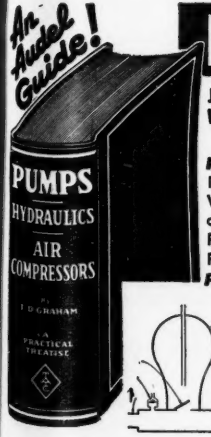

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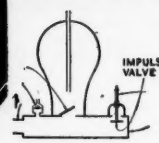

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Mont., Helena—Water Dept., has plans maturing for new pumping station for water system, with installation of motor-driven pumping unit, controls and auxiliary equipment. Entire project is estimated to cost about $92,000. Application has been made for Federal permission.

Nev., Hawthorne—Bureau of Yards and Docks, Navy Dept., Washington, D. C., has plans maturing for new cold storage and refrigeration plant at Naval Ammunition Depot, Hawthorne, consisting of several units. Fund of $680,000 has been approved for this and construction of certain railway lines. Work will be carried out at early date.

N. J., Trenton—Eastern Aircraft, Trenton Division, General Motors Corp., Parkway Ave., manufacturer of aircraft parts, etc., plans installation of electric power equipment in new one-story addition, for which work will begin soon. Cost estimated about $480,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency.

N. Y., Napanoch—State Dept. of Correction, State House, Albany, N. Y., plans extension and improvements in power plant at Institute for Male Defective Delinquents, Napanoch, with installation of additional equipment for increased capacity. Work will be carried out as postwar development in conjunction with other buildings at institution, entire project to cost close to $515,000. Harvey W. Corbett, 300 Fourth Ave., New York, N. Y., is architect.

N. Y., Albion—Woods & Sprague Milling Co., Albion, plans installation of electric power equipment in connection with proposed rebuilding of portion of multi-story flour mill, recently destroyed by fire with loss reported over $65,000.

R. I., North Kingstown—Water Commission plans new pumping station, with motor-driven pumping units and accessories, in Oak Hill district for town water supply, now secured from East Greenwich Water Supply Co., East Greenwich, R. I. Entire project will cost about $56,000. Jenks & Ballou, Industrial Trust Bldg., Providence, R. I., are consulting engineers.

Texas, McAllen—Valley Vitamins, Inc., McAllen, H. L. Titus, vice-president, recently organized, plans installation of electric power equipment in new dehydration plant on local site, consisting of four one-story buildings. A boiler house is proposed. Entire project is reported to cost over $100,000. It is understood that a priority rating has been secured.

Texas—Shell Petroleum Co., Mayo Bldg., Tulsa, Okla., plans new natural gasoline plant in Wasson gas field area, Yoakum County, Texas, comprising several large production units, equipped to process about 50,000,000 cu ft of natural gas per day, compressor station, boiler house, steel pressure tanks, pipe lines and other facilities. Cost reported over $500,000, with machinery. It is understood that project will have a priority rating.

Utah, Clearfield—Bureau of Yards and Docks, Navy Dept., Washington, D. C., plans boiler plant for central-heating service in connection with group of new buildings at Naval Supply Depot, Clearfield. Entire development will cost about $995,000. Commanding officer at Depot will be in charge. Appropriation in amount noted has been authorized.

Utah, Perry—Bear River Packing Co., Ogden, Utah, plans installation of electric power equipment in new fruit and vegetable processing and packing plant at Perry, comprising several buildings, with main unit 80 x 120 ft. A boiler house will be built. Entire project is reported to cost over $85,000. A priority rating is being secured. L. S. Hodgson, Eccles Bldg., Ogden, is architect.

Va., Norfolk—Dept. of Public Works, Norfolk, plans new pumping station in connection with extensions in sewage system, with installation of motor-driven pumping units, controls and auxiliary equipment. Fund of about $136,200 is being arranged through Federal aid for entire project. Charles B. Borland is city manager.

Wash., Seattle—Dept. of Lighting, 1015 Third Ave., plans extensions and improvements in power substation at Fourth Ave. and Spokane St., estimated to cost about $850,000, with transformers and other equipment, including line extensions. City Council is considering an appropriation in that amount for project.

Wash., Spokane—Inland Empire Electrification, Inc., 325 East Sprague Ave., V. P. Campbell, manager, will soon begin work on extensions in rural electric system in parts of Garfield and Whitman Counties, totaling about 270 miles, with substation facilities, service connections and other operating equipment. It is understood that project has a priority rating. H. A. Sewell, Newport, Wash., is engineer.

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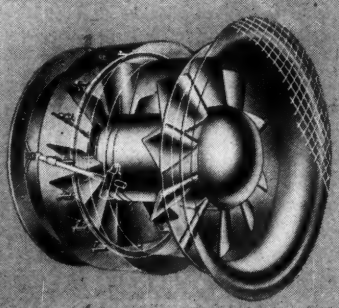

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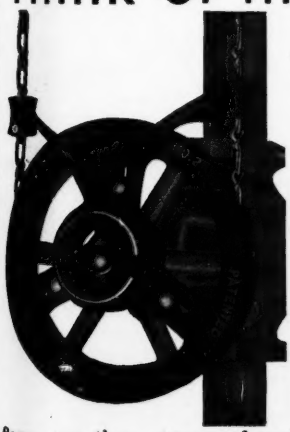

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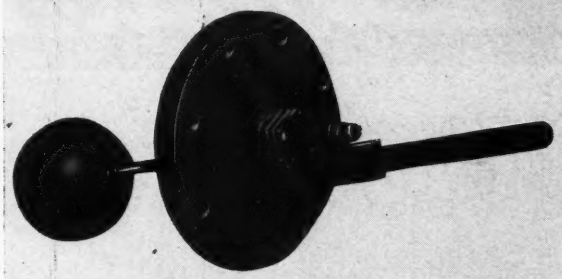

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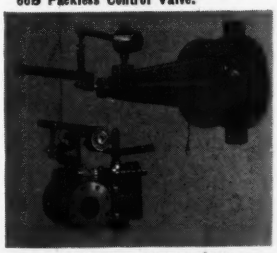

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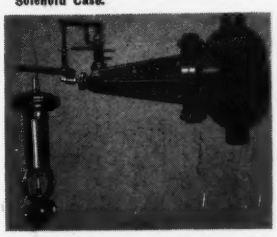

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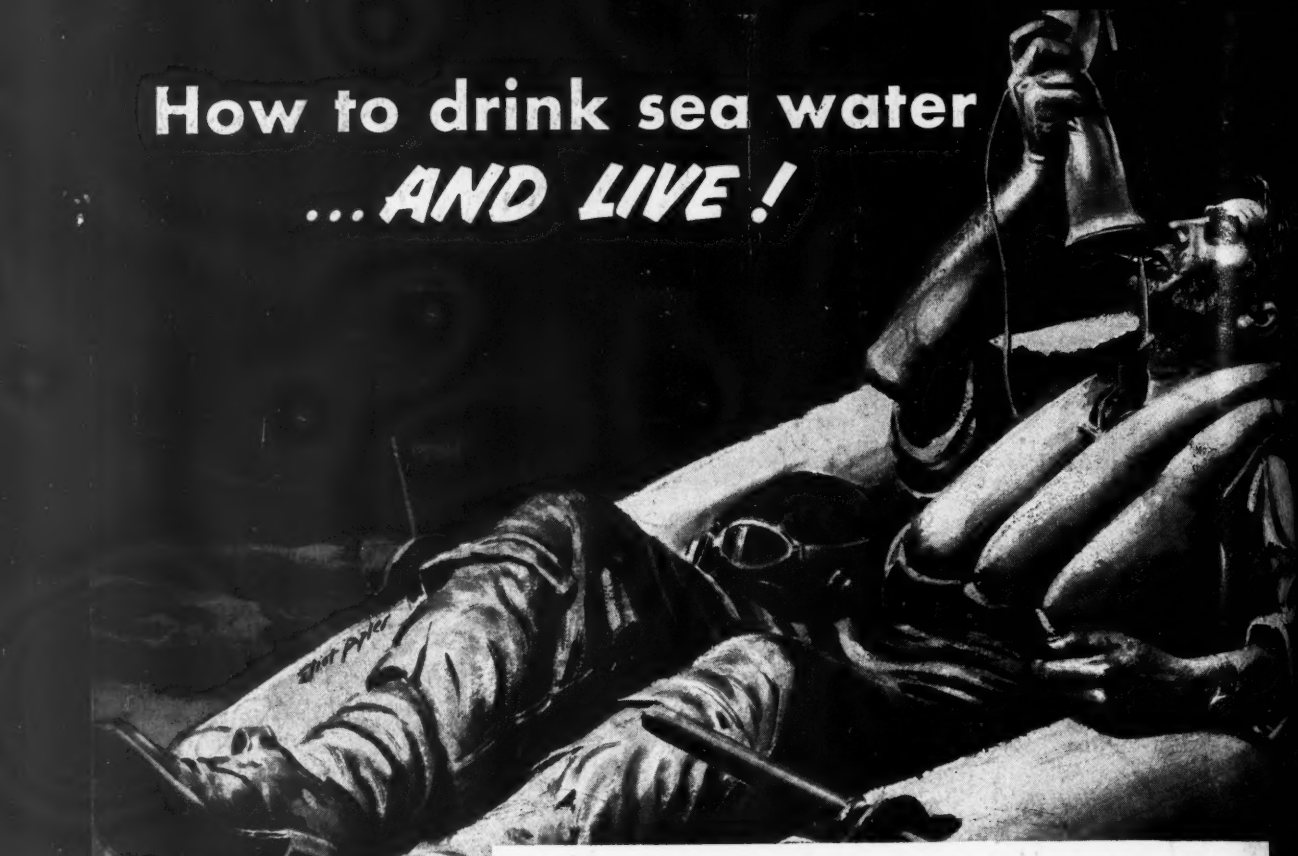

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